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The American

GAS LIGHT JOURNAL.

(ILLUSTRATED.)

DEVOTED TO THE INTERESTS OF

ILLUMINATION, HEATING, VENTILATION

AND

GENERAL SCIENCE.

VOLUME LX.

(THIRTY-SIXTH YEAR.)

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PUBLISHING OFFICE No. 32 PINE STREET

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[OFFICIAL NOTICE]

January Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, Dec. 29, 1893.

The next meeting of the Society of Gas Lighting will be held on Thursday, January 11th, at the works of the Nassau Gas Light Company, Brooklyn, N. Y.

FRED. S. BENSON, Secretary.

BRIEFLY TOLD.

THE OLD YEAR AND THE NEW.—The JOURNAL to-day begins its Sixtieth Volume, and we are pleased and thankful to be able to say that we start the New Year firm in the belief that 1894 will not be far along ere the signs of the times will point towards an active and healthy advance in every class of business. The marvelous spell of depression that marked the last half of 1893 is all but unprecedented in the trade annals of the country, nor was this depression confined to any single industry; all arts and trades shared in it and suffered from it. It seems, though, if one may read ahead through glancing at the surface lines, that confidence is being gradually restored, mainly, we presume, from the inference that we have seen the worst. It is beyond denial that much idle money has accumulated in our financial centers, and it is equally certain that money will not rest indefinitely, for money of itself is not a miser. When it is in a state of unrest it occupies its proper sphere. The inquirer who, for instance, peers over current statistics of the iron trade to determine just what the present position of that trade is, will find that stocks are virtually in the hand to mouth position; and as it is with the iron industry so is it with any other branch or division of trade that may be selected. No one can charge overproduction now, for the real truth is no one is inclined to go beyond the point of producing in excess of current demands; if anything, the production is scarcely up to the demands of consumers. But, we repeat, there is much surface indication that speculation is about to straighten out its giant limbs, and then good-bye to closed mills and downcast mill men. Turning to the gas business, it is beyond disproof that in the last half of 1893 the industry failed to more than hold its own, making the comparison directly with the corresponding half of 1892. From the statements and figures at hand, the months of November and December were very bad ones from the gas maker's standpoint, although it must be admitted that natural causes go far towards explaining the running behind. These months in 1893 were remarkable for the evenness of their atmospheric conditions. Bright, dry days were in evidence almost constantly, and the temperature was not of the average sort that conduces to the use of gas as fuel. True enough, such weather conditions are welcome and enjoyable; still, in casting about for cause and effect, the gas maker must give them due consideration. In New York city the shrinkage in gas sales during December was very marked, and mainly because of the continued fine weather, for New York manufacturing interests in general have likely suffered less than those of any other large center from the year's depression. In many of the medium sized centers the shrinkage in send-out is traceable directly to the closing down of mills and factories and shops; and in all places the average bills of the householding class of customers show a decrease that is plainly attributable to a desire for economy. However, taking one thing with another, the gas men have no particular reason for showing signs of downheartedness, in that if they who suffered in the least proportion are to be the most cheerful, 'tis they who may best show evidence of elation. The hard times, too, may be charged, at least partially, with many of the reductions in the selling rates that have been ordered this year; and if this is so, the pinch of poverty has not been without its profit. During the year we have had notification of 62 reductions in gas rates by as many separate companies, the average concession amounting to something over 30 cents per 1,000 cubic feet. Many additions have been made to the companies which have reached the dollar rate, that seemingly impossible mark of 20 years ago—and as many more are all but ready to do likewise. And this leads to the thought that while the American gas maker is coming down in his selling rates, his English brethren are unfortunately obliged to increase their prices, which rather goes to show that our grumblers at gas rates on this side of the water may eventually have to cease their favorite practice of telling us how much cheaper gas is in Europe than America. The increases in the English gas charges, however, are fairly

attributable to the wretchedly mixed up condition of the coal mining trade, which has been all but torn asunder by senseless strife betwixt the miners and the colliery proprietors as to wages and so on. Now that this turmoil is in a fair way to settlement, it is possible that English gas rates will in comparatively short time return to the normal—unless it be that the hitherto prices were abnormally low, and made possible only by robbing Peter to pay Paul. In other words, that the works were not kept up to a standard so that unduly low rates and rather high dividends to shareholders were possible for the time being. During the year just closed the proprietors of American gas works were more liberal in their provision for the improvement of their plants than customary, and had it not been for the unsettled condition of the money market, which made the sale of bonds and the placing of time loans virtual impossibilities, many of the smaller plants would have been rebuilt. These projected improvements are not to be considered abandoned, for they will be proceeded with as soon as the term of financial hesitancy is at an end. No great advances in the art of manufacture were accomplished in the year, but there was happily much evidence of a return to safe and sound principles in respect of the development of gas supply for fuel uses. The fuel gas dreamers seem to be sleeping in their nitrogenous robes, meanwhile the fuel gas suppliers are those who are now doing as they have done in the past their work on sensible lines—supplying a good illuminating gas, seeing to it that it is consumed in efficient apparatus, and taking care that the rate charged for it is as low as it can be put. No good purpose would be served by naming the fuel gas failures of the year; suffice it to say that none of them were in any degree successful. The work of the various Associations was fairly satisfactory in the twelvemonth, and the thing of most interest now in connection therewith is how the scheme for confederation will be received. The "baby" Association of the Pacific Coast showed itself a lusty infant, and the Michigan youngster also promises well. Investors in gas shares have good reason to congratulate themselves over the intrinsic merits of their investments, for no class of securities withstood the financial strain, as a whole, better than did the average gas stock. It is true some noted declines were made in shares that have often been buffeted about in our financial marts, but as a whole, the net for the year is a gain. On behalf of ourselves we may say that we have gone along in our accustomed way, with no other thought or wish than to serve the industry as a whole to the best of our ability, and we are grateful for the appreciation that has been accorded us. We have fully held our own, and have no fear that our advance will not be equal to the advance of the industry that we uphold.

Another Phase of the Brooklyn Rate War.—On the 23d of December another peculiar twist was taken in the rate war between the Companies that are contesting for patronage in the eastern district of Brooklyn. This time it was in the shape of legal proceedings brought at Albany, before Deputy Attorney-General Gilbert, instituted by the Peoples Gas Light Company, plaintiff, asking that the State commence suit for the annulment of the charter of the Greenpoint Gas Light Company, or that of the Williamsburgh Gas Light Company, on the ground that an improper and illegal consolidation between the last-named Companies had been arranged. The despatches from Albany announcing the state of the hearing say: "The applicants contended that the Greenpoint Company went into the control of the Williamsburgh Company in 1868, and since that time the Greenpoint Company has practically transacted no business on its own account. The further claim is made that the operation of the two Companies is violation of the law of 1874 forbidding any gas corporation charging two prices for gas as is the case now with these two Companies. The applicants hold that they are practically one corporation. The defense pleads the Statute of Limitations. Decision was reserved." The Williamsburgh and Greenpoint Companies to all intents and purposes have been consolidated since 1868, although the farce of an annual election in the last named has been gone on with. When the cut was made in the Peoples' district the Williamsburgh Company "leased" its pipes in that territory to the Greenpoint Company, and the latter sold gas at the cut rate, the intent being to evade the law prohibiting one Company from charging different rates in its territory. Meanwhile, what is to be the effect of this petty squabbling on the gas interests at large of the State? The Legislature—a "reform" one at that—is about to convene, and what is more natural than to presume that the "reformers" will say if the gas companies of our big cities can afford to cut rates for fun, why not oblige them to cut them in earnest and keep them cut.

Dr. Charles M. Cresson, well known in connection with the Philadelphia gas works, died at his home in that city on December 27th. He was in his 65th year.

The Existing State of the Fluid Fuel Question.

[A paper read by Admiral Selwyn, before the Pacific Coast Technical Society.]

About 26 years ago, in 1867, I took up the broblem of oil burning at the point at which I found it, from the labors of Schapposky, in Russia; Mr. Mallet, C. E., Messrs. Field and Ayden, C. E., and others in England; and Colonel Foote and several others in the United States, about 1865, of liquid or oil fuel as compared with coal. At that time the efforts of all the inventors on the subject, and there were many, were directed to burning the oil without too much smoke, and getting an evaporative duty up to once and a half, or at best twice, that of coal. Now as the calorific value or evaporative duty of coal is *theoretically* nearly 16 pounds of water by 1 pound of coal when the coal is of the very best quality, and the *practical* duty is about one half of this, or 8 pounds of water per pound of best coal, the whole being a sadly imperfect operation at best, resulting in the production of ashes, soot, smoke and slag, it seemed as if, should oil be hurnt without anything of the kind, a large advance in the production of steam must be the result. From that time to the present I have made many experiments on the full scale on all kinds of land and marine boilers, and I am enabled this evening to give you an account of the results I have obtained and demonstrated for some years past.

These results are so far in advance of everything that has been done elsewhere, either in Russia, England or the United States, that I hope engineers, whether by land or sea, will take deep note of them, and the extremely simple methods by which they are obtained. To those engineers I need hardly say anything to remind them that of all engineering work the basis is fuel, and that therefore there does not exist an engineer in the world who has not an interest in the discovery of a cheaper, or more easily managed fuel, and when I say that with the means at present easily available we can have six times the evaporative duty of coal without any stoking or stokers, for no more weight carried, and little, if any more cost per ton, they will, I am confident, think the subject an object of legitimate discussion in a technical society. On the blackboard I have given a rough sketch of the necessary appliances (for which there are now no existing patents) used by me for many years past. Any engineer can pull out his coal grate and put the furnace in in 48 hours at most, and it will not take him much longer to make the injector (atomizer) and fit the pipe and tanks. It can all be pulled out and the boiler be burning coal again, if desired, in 24 hours. But I do not believe anyone would ever wish to do it after he had once tested the result obtainable, and my experience is not a small one, as it extends over more than a quarter of a century.

Having said this much, you will perhaps permit me to go a little into the root of the matter, for no one can do anything thoroughly well unless he knows the reason why he does *that* rather than anything else. There is science in the swing of a shovel of coal, why should there not be in the use of a more perfect fuel? There are three kinds of fuel, solid fuel, as coal or wood; liquid fuel, as oil or alcohol; gaseous fuel, natural or artificial; but all must take a gaseous form before they can unite with the great supporter of combustion, the oxygen of the atmosphere. To effect this change work must be done, and this work in the case of a solid fuel requires, according to the best authority, 6 units of heat (or pounds of water evaporable) out of the 16 available. There then remain only 10 units utilizable. If, as the same authorities are agreed in saying, 2 more units disappear in waste heat going into the stack to produce draft enough to supply the air, no more than 8 units remain to give us evaporative duty, and less if after all there is smoke and soot, denoting an imperfect combustion. It is not extraordinary then that only 8 pounds of water can be evaporated by the use of 1 pound of the best steam coal in practice.

In any case where thick black smoke passes off, as much as 50 per cent. of the calorific effect is probably lost. We may now pass on to the consideration of liquid fuel. Here we have a substance consisting of carbon as before, but with a considerable proportion of hydrogen. Besides this it is on its way to become a gas, the atoms composing it are more widely separated already, and therefore not so much work disappears in effecting their union with oxygen, instead of 6 units, less than 4 units will be wanted. Owing also to the hydrogen present the theoretic calorific value will be 21 instead of 16, 21 less 4 leaves 17 units for evaporative duty instead of 10, and 16.9 pounds of water were, in 1869, actually evaporated per pound of oil used in experiment with a boiler (of ordinary marine type at that time) of 160 nominal horse power, burning heavy oil of lubricating quality, and having a specific gravity greater than salt water. This I believe to be the highest duty of which *oil alone* is capable. The experiments lasted for nine months, were under-

taken for the British Admiralty, and were under the close supervision of their own engineer the whole time.

I have all along insisted that oil of a less specific gravity than salt water must not be used on board ships, whatever may be done on land. The ship's hold is practically a confined space, in which if any gas can be given off at a less temperature than 300° F. it may form an explosive mixture with the air below deck, and blow up the ship. The heavy oil of which I speak will not give off gas at less than 360° F., and cannot be lighted or burnt at all unless it is atomized by air or steam, or else supplied with a wick. It is even less dangerous on this account than coal, which has often been known to take fire spontaneously when containing pyrites.

There is a most important difference between the blowing in of oil by means of steam as compared with blowing in with air, which is not by any means generally understood. The steam contains hydrogen and the air does not. One pound of steam (considered as water) is required to blow in 1 pound of heavy oil at common pressures, up to 50 or sixty pounds on the inch, less as that pressure is increased. This, by some persons, has been complained of as if it were a heavy tax on the boiler using oil. But as a fact for which I can vouch, each pound of steam so used produces the full calorific effect due to its hydrogen, and adds to the duty of the oil fuel 7 more units of heat, bringing the evaporation up to 22 or 23 pounds of water (measured from the supply tanks) per pound of oil and steam burnt. The hydrogen finding incandescent carbon in the furnace unites with it to form hydrocarbon, and is then burnt with the above useful effect. Roughly, in this manner, there can be obtained three times the evaporative duty of the best steam coal. Now the hydrogen being a gas is "fluid" but not "liquid" fuel. Being a gas the loss in dissociation is not more than 1 unit of heat, and it readily combines oxygen, as we know from the oxy-hydrogen blowpipe, to produce intense heat. We have therefore entered on the use of pure gaseous fuel derived from water, and automatically produced.

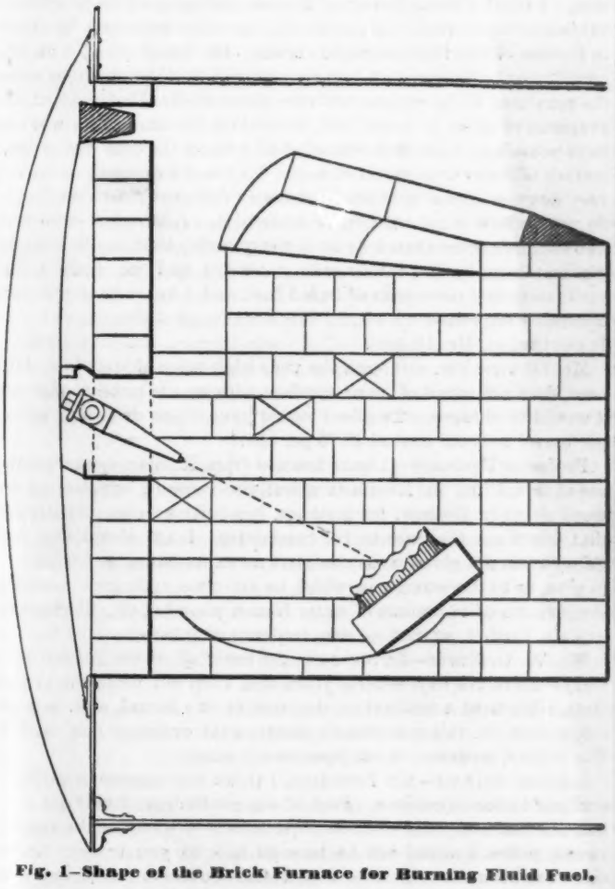

Fig. 1—Shape of the Brick Furnace for Burning Fluid Fuel.

Why, as the French say, "should we stop on so good a road?" 214 times its own volume of air is being delivered into the furnace by the steam, which also blows in and converts the oil into spray. Four-fifths of that air is hydrogen, the strongest known combustible. When in the form of nitrous acid it can be shown on the highest chemical authority to be capable in combination with 6 atoms of hydrogen of evolving 329,000 heat units.

At any rate I have long ago seen it burnt, and burnt it myself under ordinary marine and Cornish boilers with a result of measured evaporation from oil, hydrogen and nitrogen together, of no less than 48 pounds of water per pound of oil used, plus the above gaseous substances, which cost just nothing at all.

This is six times the power of evaporated or "calorific value," of the best steam coal, and will enable future engineers to drive a steamship

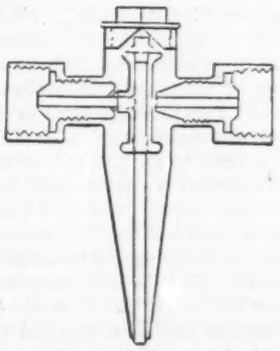

Fig. 2.—The Injector or Atomizer.

round the world, or a railway train across the continent, at full speed, with one supply of fuel weighing no more and occupying less space than a single supply of coal.

I am not yet prepared to give full information as to how the nitrogen is burnt, nor as to higher duty than six times coal, which is no doubt possible, but no changes are needed in the furnace or the injector shown, nor any other which cannot easily be carried out by a ship or railway engineer. All the figures I have given are taken from notes made during the actual working, and were checked by civil and naval engineers, to whom my work was always openly shown, in as far as I could be certain of the causes and effects. Of course, I drew many inferences, which I am slow to bring forward till everything can be tested and proved to complete demonstration, knowing well how necessary such caution is before asserting a new truth or science, or indeed any departure from long established practice however absurd it may become in the light of later discoveries. As far back as 1869 I had not only heard of but carefully examined cases of high evaporation, but I could never find anyone who knew what cause to assign it to, till I actually saw in my own furnace the apple-green flame of burning nitrogen, as described by some of the older chemists (who knew well that it was a combustible of great power, though gun cotton and dynamite had not then been invented), and got 48 pounds of water evaporated per pound of oil used by the assistance of the hydrogen of the steam and the nitrogen of the air. These latter, then, their nature and their effects have justified. I submit the new nomenclature, I have used "fluid" instead of liquid fuel, for while all liquids and all gases are fluid at our ordinary atmospheric pressure, the gases are not liquids, and such a compound fuel as I have been describing cannot properly be comprised under the term of liquid fuel.

Being fully impressed with the cardinal truth that a paper should only be "a peg to hang a discussion on," I will no longer detain those present from a discussion which I expect will be so profitable to the steam user, and therefore I hope to many among the engineers and technologists generally.

After reading the paper, Admiral Selwyn referred to a diagram on the blackboard, which illustrated the shape of his particular furnace, and the shape and arrangement of the injector or atomizer, which he explained to the Society in detail, laying particular stress upon them as the essentials in his method of combustion.

Discussion.

Mr. George W. Dickie—Mr. President, I would like to say a few words on this subject, because some of the statements made by the Admiral are rather astounding to me, especially in regard to the efficiency of liquid hydrocarbon fuel, such as the waste of petroleum. I met in Chicago Signor Soliani, of the Italian navy, who presented a paper to the Engineering Congress on this subject, and the result of a series of experiments that had been made on several vessels of the Italian navy. I may say that he is an enthusiast on the burning of liquid fuel, especially on war ships, for several reasons that do not apply in the merchant service. It can be carried on in places where coal could not be stowed, and has the advantage of easy transportation from one part of the vessel to the other. Quoting from Signor Soliani's paper, he says:

"Experiments were made by Mr. Urquhart, at that time Director of the Baku-Tiffis, and the Guazi-Tzaritzin Railways, and by Messrs. Nobel Brothers, to ascertain the heating power of oil fuel. One kilogramme of oil fuel when burning yields about 11,100 units of heat (metric system), against about 7,700 given by coal. The heating power of the oil fuel compared with that of coal ought therefore to be in the ratio $\frac{11,100}{7,700} = 1.44$ to 1."

He also mentions experiments made in England under the supervision of Mr. Sennett, of the British navy. These I have examined myself pretty closely. He experimented both with steam and compressed air in the atomizing of the oil, and he thinks there is some advantage in the use of steam. The practical ratio as given by Mr. Sennett, of oil fuel compared with coal, was 1.6 to 1. This statement, compared with the statement to night by the Admiral, is rather astonishing, when he states that the evaporating power of liquid fuel is equal to 6 to 1.

Admiral Selwyn—Pardon me, I said fluid fuel, not liquid fuel."

Mr. Dickie—In all discussion of fluid fuel we must take into account one fact, which acts very decidedly against its adoption—that is, the amount of this fluid that is available. On board ship we must have a fuel that will not ignite under 160° to 200° C. It would be dangerous to carry otherwise. The American product of this fuel is very small. Most of the residuum or waste from petroleum is consumed in our refineries, and the percentage is very low. In the Caucasus the percentage is much higher, running all the way from 17 to 30 per cent. The total product of this fuel in Russia does not exceed a million tons a year. It has been very successful in the Caspian Sea and on the Volga because it is cheap there. It is sold at 3 francs per ton. The country nearest thereto, that would reap the greatest advantage from its use, would be Italy. But there the price is from 27 to 38 francs per ton, which makes it impracticable, unless for some special purpose, as compared with coal. The experiments that have lately been carried out have been very extended and thorough, and the fluid fuel has been credited with all the saving in labor, the saving of dirt and ashes, and similar advantages, and yet we have reluctantly come to the conclusion, after a series of experiments extending over two or three years, that as matters are at present, without a vast increase of the product, and without a cheapening of it in the maritime stations where it would be used, coal not only holds its own against it, but the percentage in favor of coal is very high indeed. In fact, from the statements made to me by Signor Soliani, the difference is as 2 to 1. I make these statements to-night because I am fresh from a lengthy discussion of this subject by some of the ablest men who have taken it in hand. There is a vast amount of petroleum fuel used in this country in its crude state, but it would not be desirable on board ship. We have used it here in San Francisco Bay, and the results have been rather disastrous on account of the volatile nature of the fuel. Petroleum fuel is used for the production of steam at the Exposition, but the kind there used cannot be successfully applied at sea under the present method of using it.

Prof. H. B. Gale—I have been greatly interested in the paper before us. It states some results which are certainly very surprising. If they can be well substantiated, the author has made one of the greatest discoveries of the age. I have followed very closely the published accounts of experiments made on fuel, particularly liquid fuels, and have witnessed some experiments with oil, but have never seen or heard of any results approaching anywhere near to those reported in this paper. I think if the author expects the world to accept such wonderful results as six times the evaporative duty of coal, as reliable, that he should give more details as to the methods of the particular experiments where he has obtained such results. I know from experience that it is very easy in making tests of the evaporative qualities of fuel to be led into serious errors from side causes. It has been known for some time that a certain heating effect is sometimes produced by the combination of nitrogen in the manner described. Some years ago I listened to a paper at the Academy of Science in St. Louis, on this subject. The result of the experiments then reported was that the amount of heat obtained from the nitrogen was extremely small, and practically of no account. Now, if it is possible to increase the effect of this element to such an enormous extent by the use of the particular furnace and fuel described by Admiral Selwyn, it is certainly something worthy of very profound and careful investigation. But I must confess that the paper has failed to convince me that this is possible. The furnace does not differ very essentially from some other furnaces which have been used in a similar way for burning oil fuel, and no such effect has been produced. Twice the effect of coal has been considered about the maximum that could be obtained. Again, if compounds of nitrogen were formed in appreciable quantity in the case described, we should expect they would have some effect upon the metal of the boiler; and if nitrogen were consumed to the extent claimed, we should have in the analysis of the gases the evidence of that, and the proportion of nitrogen which was burned. From the analysis given I did not see that there was any evidence of such action, but rather the contrary. It is possible that the author has the results of an analysis which shows the combustion of nitrogen, and the amount. If he has such it would be very interesting to know it. I am not sure whether the calorific effect of a pound of nitrogen burned in this way is known to chemists, but as we have some chemists here with us this evening, I should be pleased to hear from them on this point.

Mr. Wagoner.—I have looked into this matter of fuels, both solid and liquid, several times, and I think the calorific values that are usually given may be accepted as correct. Beginning with green wood, whose value is about 4,000 heat units per pound; dry wood may be taken at 6,000; coal, such as comes to San Francisco, ranges from 10,000 to 14,000 units; coke, 12,000 to 14,000; tarry refuse oil from the refinery, 16,000; and crude oil, California, 18,000 units. These figures are the practical results of tests made under boilers by me at various times and places, and they are sufficiently near correct to enable the engineer to make a choice of fuel. Concerning the remarkable results claimed in the paper read this evening, I do not think anyone well informed would admit the possibility of burning nitrogen in the manner claimed; therefore, whatever heating effect was obtained by the experimenter was that due to the formation of CO_2 and CO, and the analysis of waste gases showed such was the case. One fallacy which is quite common deserves mention—*i. e.*, the burning of water as fuel. The proponents forget that it takes as many heat units to dissociate steam as can be gained by the recombination of its elements, and with any other combination of said elements there would be a loss of heat.

Mr. Stut—A few years ago I read a number of articles on this question. I think Prince Henry of Prussia instigated an investigation of the subject of liquid fuel, to ascertain the possible economy for the nation in the use of this fuel on torpedo boats. He noted what had been accomplished in England and other countries. If I remember correctly, the results of his investigations were about as Mr. Dickie stated, that the evaporative effect of liquid fuel, as used on the Black Sea, was about 11 to 12 pounds of water to a pound of oil; while the coal would be 7 or 8 pounds of water to a pound of coal. Unless the amount of this fuel is very large, and can be obtained at many different places on the globe, I do not see how much use can be made of it. Admiral Selwyn probably knows much more than I do as to the quantity that can be supplied. I was employed by Mr. Dickie some years ago, and we made a little investigation and some tests of liquid fuel, and I know that we were not favorably impressed with it. I think we found it cheaper to burn coal. Is not that so, Mr. Dickie?

Mr. Dickie—Yes, although the very high price of that fuel, delivered here, does not admit of its comparison with its use in other places where it would be cheaper. This fuel would have to be delivered at 75 cents per barrel to equal coal at $5.75 per ton.

Professor Reuleaux—I have learned from Russian engineers that the use of liquid fuel in Russia is about the same in expense as coal or wood; that in Moscow, for instance, it is fully as cheap to use oil, but that this is not the case in St. Petersburg. I am afraid that Admiral Selwyn has not given us as complete an explanation as he may be able to give, as to the manner in which he arrives at such great results as the evaporation of 48 pounds of water from a pound of oil. Perhaps he will explain further, so that we may understand it better.

Mr. W. G. Curtis—In regard to the use of oil on the *Solano* and other ferryboats of the bay, several years ago, I am not prepared to state the facts. We used a residual oil that cost $1.40 a barrel, and, as near as I can remember, this price would about equal ordinary coal at $6 a ton. The matter, however, is not fresh in my mind.

Admiral Selwyn—Mr. President, I think my answer must be a general one to the objections. First of all, gentlemen, I may say that if I had not had every one of these objections before me for the last six and twenty years, I would not be here to talk to you to-day. Secondly, there has been the most careful and skilled observation of every trial I have made by both civil and naval engineers. Everything was watched to see that there was no possibility of error in the measurements, the water was measured into the tanks, and out again to find what had evaporated, and thus the process was subjected to every test known to engineering. Therefore there is no doubt or question about what I am saying. In the first place, as to the *supply* of fluid fuel, for that is really the most fatal objection, if it be not obtainable. I think you all know that the coast of South America has oil that is constantly running into the sea. My friends Treadwell and Noble have 20 mills there, and can send you just as much oil of any quality you choose to ask for.

Next, in speaking of our supplies, we have inexhaustible oil works. The shale of England is 10 miles wide and 650 feet deep wherever we have gone to the bottom, extending across to Germany and Russia, and that will furnish more oil than we can use if the world lasts another thousand years. I am not here to tell you of a new thing, but of a thing which I have studied, and in which I have been a leader for the last 20 years. The Germans, Italians and Russians have made inquiries about it from me, and came and studied in my boiler room at London. If they do not get the effects I have produced and vouch for, it is not my fault. If they will follow what I have given they will find that what I have said is borne out by the facts. In regard to the use of oil on the San Francisco ferryboats, some were successful experiments and others were not so. Consldering that these experiments were made in the same locality, did one set of engineers do wrong and the others do right? We must presume so. Fifty-five per cent. economy was worth considering, though this is very little, and much less than I got when I started my work in 1887. There are gentlemen who have come to me and examined my work, and have gone away and again tried to imitate it without asking me about it; they were not willing to be instructed, and their labors stopped there. I think you will find that in Germany they have followed the old ways in using this fuel. In Russia they are burning it against all the laws of combustion, in a boiler surrounded with water. I am in communication with a gentleman there, who keeps me informed of the methods employed; they are still very far behind in it. But if they get 12 pounds of water evaporated from 1 pound of oil, the subject is worthy of discussion.

Mr. von Geldern—It is unfortunate that the author is unprepared to fortify the statements he has made, with data obtained from direct experiments. As long as we are left without actual figures, we cannot be expected to consider a subject for which such extraordinary results are claimed. An enthusiastic author must be prepared to submit more than generalities, if he would expect a detailed discussion of the subject he has chosen to present before a technical society. In the present state of the fluid fuel question, our worthy guest has not been without his co-laborers, and all data heretofore available have not led to the sanguine conclusions drawn by him this evening.

Steam, Heat and Water.

By Mr. John M. Taylor, in the *Master Steam Fitter.*

Steam is pure water expanded by heat into an invisible vapor. Perfect steam is in no way moist, but is as dry as are the permanent gases. It has in a complete degree those properties of fluidity, mobility, elasticity and quality of pressure in every direction that distinguish gases.

Saturated steam is the normal condition of steam generated in free contact with water, and the same density and same pressure always exist in conjunction with the same temperature. It therefore is at both its condensing and generating points—*i. e.*, it is condensed if its temperature is reduced, and more water is evaporated if its temperature is raised.

The pressure and density of steam, generated in free contact with water, rise with the temperature, and reciprocally its temperature rises with the pressure and density. The higher the temperature the more exactly proportionate to the variations of temperature. Under this condition, steam is termed "saturated" from its containing the largest amount of water possible at any given temperature.

The pressure of steam at a boiling point of 212° is equal to the pressure of the atmosphere, which is 14.7 lbs. upon a square inch.

The expansive force of the vapor of all fluids is the same at their boiling points.

A cubic inch of water evaporated under ordinary atmospheric pressure is converted into 1,640 cubic inches of steam, or nearly 1 cubic foot, and it exerts a mechanical force equal to raising 14.7 × 144 = equal 2,120 lbs. 1 foot high.

One pound pressure of steam will support a column of mercury = 2.0376 inches high.

The boiling point of water varies with the pressure of the atmosphere or vapor under which it is effected.

Steam for heating purposes possesses an advantage over hot water in the ease of its application where great inequalities and frequent alterations of level occur, and particularly when the boiler must be placed higher than the place to be heated. For buildings occupied at intervals, steam is more effective than hot water in its rapid generation of heat.

The most prominent of the properties of steam are its high expansive force, its condensation by the abstraction of its temperature, its concealed or undeveloped heat, and the inverted ratio of its pressure to the space it occupies.

The expansive force of steam arises from the absence of cohesion between and among the particles of water. If a known volume of steam of a certain pressure be made to occupy but one-half of its volume, its elastic power will be doubled.

Steam has an expanding force always equal to the pressure under which it is generated, and its temperature theoretically is always the same as that of the water in contact with it.

The sum of its sensible and latent heat is always the same and is equal to 1,146° above the freezing point of water. Under ordinary atmospheric pressure 27.222 cubic feet weigh 1 pound, and it has a gravity about equal to one-half that of air at 34°; but if the temperature of air be increased 160°, the gravity of steam will equal two thirds of the weight of air.

Heat is simply a mode of motion or an influence by which motion is produced among the atoms of substances. The motion is imperceptible, heat being detected only by sense of feeling.

It is a universal force, and is referred to as cause and effect. Heat and cold are conditions and not substances. They are relatively, not absolutely, different, being merely higher or lower degrees of heat.

The three most apparent effects of heat, so far as they relate to the form and dimensions of bodies, are expansion, liquefaction and vaporization. Its effect is most evident in those bodies which are the least influenced by the attraction of cohesion; thus in solids it is comparatively trifling, in liquids it is much greater, while in gases it is very considerable.

The force with which bodies expand and contract under the influence of an increase or diminution of heat is irresistible, and is one of the greatest forces in nature.

The ratio of expansion in solids and liquids increases with temperature, while in gases it is sensibly uniform at all temperatures.

A unit of heat is the quantity of heat necessary to raise 1 lb. of water 1° F.

Specific heat is the capacity of a body for heat, and is the number of heat units necessary to raise 1 lb. of any substance 1°. The specific heat of all bodies, except gases, increases with their temperatures.

Latent heat is the number of heat units absorbed by any body in passing from a solid state to a liquid or from a liquid to a gaseous condition.

Heat is transmitted or lost by radiation—projected in rays and in straight lines. By convection rising in fluid masses or through flues. By conduction—passing from one body to another in contact.

The heat necessary to warm a pound of water 1° will warm about 4.2 pounds of air 1°, or 2.1 pounds of vapor of water, or 9 pounds of iron, or nearly 2 pounds of ice 1°. The heat necessary to convert 1 pound of water from 178° (which is about the temperature of return water) to steam is about 1,000 units, and this will heat 52,000 cubic feet of air 1°, or 5,200 cubic feet 10°, or 52 feet 100°, without making allowance for the increase of its bulk because of its expansion, which for a difference of 100° will equal nearly 20 per cent. of its original bulk.

Water.—Whether as a solid, liquid or gas, water is one of the most wonderful substances in nature. At all temperatures above 32° F. the motion of heat is sufficient to keep its molecules from rigid union; but at 32° the motion becomes so reduced that the atoms seize upon each other and aggregate to a solid.

It is composed by a chemical union of oxygen and hydrogen in the proportions of: By weight, oxygen, 88.9 parts; hydrogen, 1.11 parts. By volume, oxygen, 1 part; hydrogen, 2 parts.

Liquids transmit pressure equally in all directions, unchanged and without loss of power. This equality of pressure is their most characteristic property.

Water at 1,000 ounces is assumed as unity in the comparison of gravity of different substances.

It evaporates at all temperatures, dissolves more substances than any other agent, and has a greater capacity for heat than any other known substance except hydrogen gas.

Twenty volumes of water absorb one volume of air under atmospheric pressure.

A miner's inch is a measure for the flow of water, and is an opening one inch square through a plank 2 inches thick, under a head of 6 inches of water, to the upper edge of the opening. It will discharge 11¼ gallons in one minute.

A cylinder 3½ inches in diameter and 6 inches high will hold almost exactly one quart, and one 7 inches in diameter and 6 inches high will hold very nearly one gallon.

The ratio of fresh water to salt water is about as is 36 to 35 by weight.

Radiation is effected by nature of surface of body; thus, black and rough surfaces radiate and absorb more heat than light and polished surfaces.

Bodies which radiate heat best absorb it best.

Radiant heat passes through moderate thicknesses of air and gas without suffering any appreciable loss or heating them. When a polished surface receives a ray of heat, it absorbs a portion of it and reflects the rest. The quantity of heat absorbed by the body from its surface is the measure of its absorbing power, and the heat reflected that of its reflecting power.

When temperature of a body remains constant, it is in consequence of quantity of heat being equal to quantity of heat absorbed by body.

Reflecting power of a body is complement of its absorbing power; or sum of absorbing and reflecting powers of all bodies is the same. Thus, if quantity of heat which strikes a body equals 100, and radiating and reflecting power each 90, the absorbent would be 10.

Air and gases are very imperfect conductors. Heat appears to be transmitted through them almost entirely by conveyance, the heated portions of air becoming lighter, and diffusing the heat through the mass in their ascent. Hence, in heating a room with air the hot air should be introduced at lowest part. Convection of heat refers to transfer and diffusion of heat in a fluid mass, by means of the motion of the particles of the mass.

A low pressure gravity apparatus is the most healthful, economical, cleanly, and perfect heating appliance known, and may be constructed to heat a single room or the largest building with a uniformity that cannot be attained by any other means.

A gravity apparatus is one without an outlet whose circulation is perfect, wasting no water and requiring no mechanical means for returning the water of condensation to the boiler. It has been very properly likened unto the circulation of blood in the human system.

This form of apparatus is extensively employed in warming private houses, churches, schools and other public buildings, with very satisfactory results. Its chief merits are its safety, noiselessness, the ease with which it is managed, the low and uniform temperature of its surfaces, and the positive return of the water of condensation to the boiler under all conditions.

A low pressure gravity circulation apparatus consists of the boiler with its various attachments for the automatic regulation of its draughts and pressures; main steam pipes and risers for conveying the steam to the various parts of the building to be warmed, and the corresponding return risers and mains for the return of condensation to the boiler; relief pipes for relieving the mains and risers of the water of condensation, and for equalizing the pressure throughout the apparatus; radiators for the several rooms to be warmed, with their necessary valves and connections.

Goetz's Apparatus for Purifying Gas.

On August 15th U. S. Letters Patent (No. 503,133) were granted to Mr. Joseph Goetz, of Berlin, Germany, for improvements in apparatus for purifying coal gas. Using the words of the specification:

This invention, which relates to apparatus for eliminating or separating ammonia and tar from coal gas, has for its object the provision of

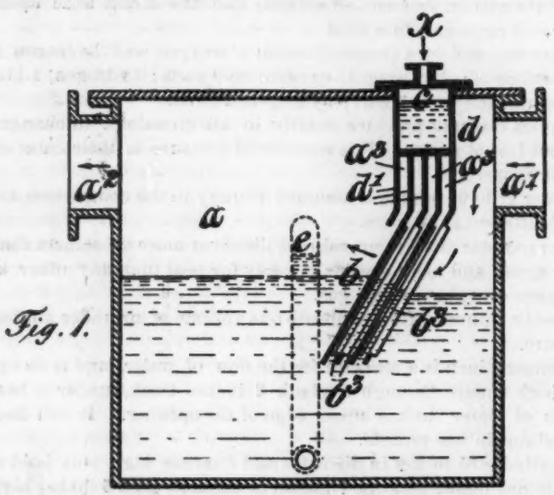

Fig. 1.

means whereby the separation is more effectually and economically attained than heretofore, and consists essentially in the construction of the apparatus, as will now be fully described, reference being had to the accompanying drawings, in which Figure 1 is a vertical section of an apparatus constructed according to the invention, and Fig. 2 is a detail view in perspective of a portion of the separator.

One of the essential features of the invention consists in the construction of the separator so as to form a series of zigzag channels or passages for the gas, and in the combination therewith of means for supplying an absorbing liquid to the same. The zigzag channels or pas-

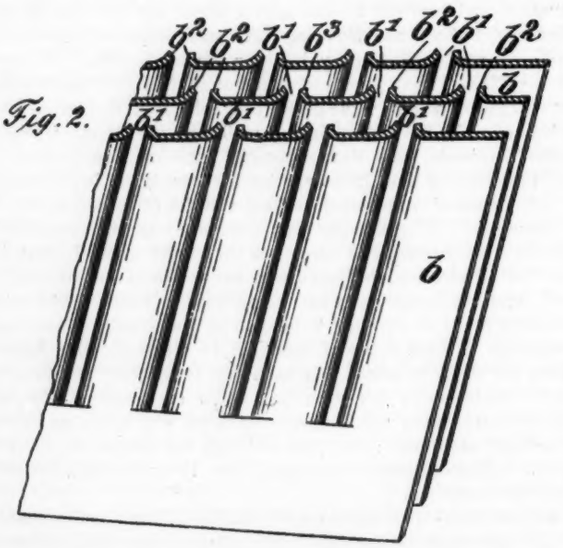

Fig. 2.

sages are obtained by means of a series of sheet metal inverted gutters b, in such manner as to leave a very narrow slit or passage b^1 between adjacent gutters, and so that one series of gutters will overlap or straddle the narrow slit or passage b^1 between the gutters of the series in rear or below. In practice the superposed series of gutters are so arranged that the side walls b^2 of the gutters of one series will lie in such proximity to the gutters below or in rear as to leave a narrow slit or passage b^3 between them, as shown in Figs. 1 and 2, whereby the zigzag passages are obtained. These sheet metal gutters b are arranged on an inclined plane within a suitable box a, each individual series extending clear across the box, thus forming, so to say, a slotted partition, and the length of the gutters is so chosen that their lower edges will be some distance from the bottom of the box a, which is thus divided into two compartments that communicate with each other below the separator. The upper end of each transverse row of gutters b is secured to a vertical partition d^1, extending across the box a, the series of partitions dividing the box at this point into a series of narrow chambers a^3. The lower end of the partitions d, to which end a transverse series of gutters is secured, is bent to hold said gutters at the desired inclination to a vertical, as shown in Fig. 1, while the upper end of said partitions is secured to the bottom of a feed box c that extends also across the box a. The bottom of the feed box is perforated along the chambers a^3, and water or weak ammonia liquor enters said feed box at x, while the gas enters at a^1 on one side of the separator and flows out at a^2 on the opposite side of said separator, both the gas inlet and outlet being at the upper portion of the box a, which is also provided with an overflow pipe e.

In Fig. 1 are shown four superposed, transverse series of gutters b, but the inventor does not desire to limit himself to this number, which may be increased or decreased according to the volume of gas passing through the apparatus, nor does he desire to limit himself to any particular cross sectional area of the individual gutters, as this may also be varied without departing from the nature of the invention.

In practice he finds that the separation of tar takes place in the gutters nearest to the gas inlet, while the separation of the ammonia takes place chiefly after the gas has passed the gutters nearest said gas inlet, so that the apparatus performs the double function of washer and scrubber. The separation of the ammonia and tar is based upon the fact that the gas is compelled to pass in a zigzag course through passages that are luted with a film of liquid, either water or weak liquor. This luting is obtained through the medium of the feeding devices described, the liquid being supplied under sufficient pressure to form jets which are projected into the chambers a^3, and onto the upper face of the gutters over which the liquid flows to the edges, and as to the spaces between the gutters of a transverse row and those between such row and the next succeeding one are narrow, said spaces or slits are covered or closed by a thin layer or film of liquid through which the gas is compelled to flow, since it cannot flow around the separator as the lower end thereof is luted by the liquid in the box. The gas will necessarily take

the course referred to owing to the difference in resistance to its flow, the film of liquid that seals the passages b^1, b^2, above the level of the liquid in the box offering less resistance to the flow of the gas than the body of liquid within said box. Continuing, the inventor says:

I have also found that when the apparatus has been in use the slits or passages of communication, b^1, b^2, between the gutters are not only luted and sealed by a film of liquid, but also by a film of tar separated from the gas, so that the latter remains in contact with tar until it escapes from the outer transverse row of gutters, or substantially so, which is an advantage as is well known, and has the further advantage of increasing the resistance to the flow of the gas, and thereby more effectually separating the dust, ammonia and tar therefrom.

Inasmuch as the direction of flow of the gas is changed as it passes from one transverse row of gutters to another, and in view of the fact that the gaseous currents meet one another or collide, a constant and somewhat violent agitation or mixing takes place, which materially facilitates the separation of the ammonia or tar as it passes through the liquid films and over the liquid flowing along the upper and under side of the gutters.

In practice I form the gutters *b* of single pieces of sheet metal, so as to give them a greater rigidity and the necessary resistance to the pressure of the gas.

It is obvious that the feed box *c* may be divided into two compartments by a suitable partition for the purpose of supplying thereto different liquids, as for instance, weak liquor to one and water to the other of the two compartments, and this will be found of advantage when large volumes of gas are passed through an apparatus constructed as described.

In practice I make the overflow pipe *e* adjustable vertically, so that the level of the liquid within the box *a*, and consequently the area through which the gas passes, may be varied in accordance with the volume of gas entering said box.

The adjustment of the overflow pipe *e* may be effected by hand in any desired manner, or automatically by the provision of suitable mechanism controlled by the pressure of the gas entering the box *a*.

In order to avoid essential variations in the adjusted level of the liquid within the box, due to varying volumes of gas entering the same, and to reduce as much as possible the transmission of these variations to the entering gas, I so arrange the separator that the chamber formed thereby at the inlet side is of considerably less area than that at the outlet side, so that an increase in the pressure at the inlet side of the separator will cause the level of the liquid to sink correspondingly, while owing to the greater area of the chamber at the outlet side of the separator the level of the liquid will not be materially affected.

Professor Hempel on "American Lighting Gas."

According to the *Gas World*, at the last meeting of the German Gas Association, Prof. W. Hempel, of Dresden, read a paper giving a summary of his own observations and experiences during repeated visits to America, which paper will be found *in extenso* in the *Journal fuer Gasbeleuchtung*, 1893, No. 24. The Professor is considerably astray in the statement of some of his facts, and is also out of bounds in the matter of his figures. For instance, Messrs. Wilkinson and Allen, of the New York Mutual Company, will be astonished to learn that they are in the gas making business only incidentally, the Professor asserting that their main operation is the preparation of wood charcoal, which is so largely used "for the cooking of oysters" in New York. Then, again, respecting the growth of the use of "pure heating gas" in Chicago, which we are told is spreading, whereas the plain truth is that the Mutual Fuel Gas Company, of Chicago, which had been sending out a fuel gas, is now manufacturing and distributing only an illuminating gas. However, according to the abstract, the Professor after reminding his hearers of the existence of considerable fields of anthracite and of petroleum in the United States, and of the effect which these resources have on the appropriateness of one or another system of making illuminating gas, he went on to point out that there are also large fields of coal suitable for ordinary gas making in Virginia, and in the Middle States. Still, as it is cheaper to carry by water than by land, till within the last ten years it was cheaper to import English gas coal than to work the Virginian fields for the gas works of the Eastern States. The position is now different, but still the new processes have, to a great extent, supplanted the old one of making gas from gas coal. Tessie du Motay, the unfortunate inventor, was the first who went beyond the old idea of making water gas by blowing steam through glowing coke, by introducing producer gas.

Professor Hempel has, personally, no doubt that in the future all illuminating gas will be made, if not in a producer, in some analogous apparatus; for a producer is much more favorably situated with respect to getting it heated than a retort is. Further, the transference of heat from molecule to molecule is more readily effected in a producer. Tessie du Motay's process of alternately blowing up with air and sending steam through to make water gas suits the American anthracite, which has only about 4 per cent. of ash. The New York Gas Company uses a modification of this process, in which the water gas is passed over lime to remove the carbonic acid, and is then carbureted by naphtha in retorts. The steam is superheated by being passed through pipes laid between the two alternately-acting sections of the producer. The naphtha is allowed, while surrounded by hot water, to flow down steps, where the uncarbureted gas picks up the vapor, and the mixture goes on into fixing retorts arranged so as to permit the gas to go through very slowly. The lighting power is very high, and the percentage composition is 3.1 carbonic acid, 15.6 heavy hydrocarbons, 25.2 carbonic oxide, 26.6 marsh gas, and 1.2 nitrogen. The process gives a high lighting power with relatively little naphtha, but is only used by one works, and would, in all probability, be a good deal modified in its details were it not for patent-right questions. Herr Hempel then described the Lowe process, and returns the average percentage composition as 0.3 to 0.5 carbonic acid, 14 to 15 ethylene, 27 to 28 carbonic oxide, 25 to 26 marsh gas, 24 to 27 hydrogen, and 3 to 4 nitrogen. This high proportion of carbonic oxide caused it to be for some time forbidden in some of the States of the Union, but now even Massachusetts permits its use, statistics having shown that the number of fatal accidents from its use is not great in practice. Water gas in America usually means a mixture of water gas with oil gas, to which a disagreeable odor has been imparted.

Dr. Hempel went on to describe the Granger process and the Haulon and Leadley process, as also the lime gas process, which is based upon an idea that oil vapors and steam, brought into contact with red hot lime, will not form carbonic oxide, but will syntheise into hydrocarbons, an idea for which there seems, so far as analysis shows, to be no foundation. The effect of the lime is simply that of so much incandescent material, operating by surface contact, together with this, that the use of lime for this purpose gets over certain difficulties connected with patents. The Mutual Gas Works of New York makes a good deal of gas in the preparation of wood charcoal, for which there is a steady demand for the cooking of oysters in that city. The McKenzie process is a continuous one for the treatment of anthracite and naphtha, with a regulated admission of air. Lime is greatly used for purification, and in many places the spent lime is simply taken away and thrown into the sea. The price of gas is generally about a dollar a thousand cubic feet; the Lowe gas costs about 28¾ cents to make, including 6¼ gallons of naphtha and 62 pounds of anthracite, while the older process costs about 41¼ cents per thousand. Purely heating gas has made no success; it is too poisonous to be sent out without being odorized, and it does not pay to lay special mains for it.

As to the introduction of these processes in Germany, Dr. Hempel does not speak very encouragingly. The cheapest gas oil in Germany costs from 7.68 cents to 8.44 cents per gallon, while in America the naphtha used there costs only 2.84 cents. Still, the manufacture of water gas is very well understood on this side, and it is not necessary to supply such very high lighting powers as are provided in America; so that a generator may well be used to supplement the ordinary gas supply, particularly if the apparatus be so contrived that the coke may pass direct from the retorts into it. In that case enrichment might be secured by retaining at the gas works those fractions of the distillate from the tar, which are now sold away at unremunerative prices.

Dr. Hempel also drew attention to the high price of large masses of retort graphite. This material is also useful in many ways nowadays, particularly in making electric carbons and electrodes, but it does not seem to be attended to by gas makers. People are now going in on the largest scale for making caustic soda and chlorine by the direct electrolytic decomposition of common salt, and for that they require large gas carbon electrodes, but cannot get them. Could not the retorts be so shaped as to yield graphite at once in large workable plates or slabs? And it ought to be easy to get thick copper or iron conductors embedded in the carbon in the retort itself.

In the discussion which followed the paper, Herr H. Dicke, Berlin, said that pure heating gas was not so far behind in America; the Fahnehjelm Light Company had 25,000 magnesia combs a going in Chicago, and the use of them was spreading. Dr. Bunte questioned the utility of tar for enriching, on the simple ground that tar only begins to decompose at a temperature which gas will not stand. Dr. Hempel replied that it makes a great difference whether we simply heat hydro-

carbons or heat them along with some substance which can give off oxygen; the gas from a water gas producer contains at any rate 4 per cent. of carbonic acid, unless the temperature has been relatively very high; and the oxygen of the carbonic acid breaks up the hydrocarbons. But he adhered to his proposition that gas works should effect a rough fractional distillation of their tars, and sell only the more valuable fractions, reserving the heavy oils for enrichment, a procedure which would place at the command of the gas manager a means of forcing his production so as to meet any unexpected demand. Dr. Kramer, Berlin, pointed out that the hydrocarbons of tar are poor in hydrogen, and that the material is not suited for the production of illuminating hydrocarbons. At low temperatures you cannot get tar components to take up more hydrogen, and at temperatures sufficiently high you spoil your products. The question of import duty on petroleum in Germany has also a vital bearing on the suitability of the Lowe process in that country. English experience does not aid, for there it is imported duty free. In Alsace there is now an oil-boring industry, but the whole yield last year was only 11,000 tons, a quantity which would not suffice for the German gas industry.

The Tesla Engine.

In the course of an address delivered a few days ago before the New York Electrical Society, by M. Nikola Tesla, the speaker remarked:

You have seen a few designs of engines described by the eminent speaker who is one of the most competent to talk on the subject, and who has shown us a great many complicated mechanisms. They are exactly adapted to illustrating what I have to say, and I would ask whether it is not worth while to attempt to simplify those mechanisms, which we have been using heretofore for the production of electric currents. When we look at a steam engine and inquire where the power comes from that drives the steam engine, we will always find that the power comes from a little box—a cylinder with a piston in it—and all the other appurtenances are really but to keep it going. You may do away with the flywheel, with the cross heads, with the eccentrics, with all the appliances, provided that you can in some other simple way govern the motion of the mechanism. So then my first idea was to apply the motion of the piston, which is freely movable, to a magnetic field, to move a magnet or a coil in a magnetic field and so generate currents by this direct motion.

Now let us see what we can do in that respect. First, we reduce the weight of the engine for the same pressure and the same piston speed to 1-30th or 1-40th if not 1-50th of its weight. Furthermore, we do away with all mechanical frictions. The engine designed according to my deas has a mechanical efficiency of 99¼ per cent. Now, that is in itself a very big item and renders it worth while endeavoring to make this mechanism a commercial success. But there are other far greater things. You will find that engineers often say what an advantage it is o apply the direct motion of the steam piston to a pump. In reality the advantage in a pump is but a very minute one. The water column has got an enormous inertia, and what we do gain in the direct acting pump is merely a matter of overcoming some additional frictions which we have in the ordinary engine. We may take the mechanical efficiency—I gather the data from various works—we may take the efficiency as say 81 to 82 per cent. at the full load. But the efficiency is much less on a varying load. Then, furthermore, we have got these variously estimated. I take the figures which I have found to be fair, giving this as the efficiency. Now the dynamo again has got mechanical losses due to friction, and, furthermore, the wire is never utilized fully in the dynamo. In my construction the dynamo may consist of a simple coil of the magnet, and a simpler coil, which is all immersed in the magnetic field. There is no useless wire. Consequently dynamo and engine, if they are reduced considerably in weight, increase in efficiency.

There is only one engine which can equal it in output, and that is the turbine. With the steam turbine we can obtain an enormous output, and that is the reason why the steam turbine, in my opinion, may be found a valuable adaptation for driving dynamos; and then convert the motion by means of alternating dynamos; and I think the steam turbine has in itself a physical cause why it cannot surpass a certain efficiency, and that is that we drive turbines by impact. A turbine might be very efficient if the medium which propels it were incompressible and homogeneous. But it cannot be efficient if we drive it by means of isolated shocks. Furthermore, we cannot in a turbine gain all the expansion. These causes, I think, will limit the efficiency obtained in turbines. But in reciprocating mechanisms we can, provided we obtain a sufficiently high speed of the piston, expand the steam at an enormous rate.

It is perfectly practicable in these mechanisms which I have been working up to obtain, if you want a speed of 100 meters a second, and while I do not contemplate producing such speeds, yet it is quite possible to do it. But since we can produce higher speeds we might as well increase the speed two or three times, and so augment the activity of the mechanism and raise the efficiency. Furthermore, as I am enabled now to work without a packing, I found that in these mechanisms the packing is actually objectionable, the expansion occurring at an enormous rate, and the engine being of such character that the exhaust can be reduced to pretty nearly the atmospheric pressure very easily. The mechanical friction is reduced to such a small figure that we can raise the temperature of the steam very considerably.

You know that in high pressure steam engines one of the greatest troubles is the lubrication. We can go so far with the mineral oil, we can go so far with ordinary oil, but then we reach a point at which we cannot go any further; the lubricant will not work; and I am informed by very able practical engineers that about 250 pounds per square inch of steam pressure is as high as we practically go. With this engine we can go much higher. I am now preparing a boiler which will give me up to 350 pounds pressure. It is very important, of course, to get the pressure very high. In these mechanisms we are confronted with two things. For what are they going to be used—for light or for power? If we want to drive motors we must have a long stroke and a slow frequency. If we want to operate lamps then we want a very short stroke and a very rapid motion. To have a high speed with short stroke we must have a great initial pressure, because, you know, the number of vibrations increases only as the square root of the pressure. So if we want to have twice the number of vibrations we must have four times the pressure. But, on the other hand, four times the pressure and twice the number of vibrations means eight times the output. So it is very important in this mechanism in which the power depends on the square to obtain as high a pressure as possible. It is on this line now that I am working.

We have had such reciprocating engines as far back as 1868 or 1870, and it would be a very erroneous idea to think that I had evolved something radically novel in that part of the mechanism.

It is more economical to produce rapid vibrations than low vibrations. But so far as the economy of the dynamo is concerned, and so far as the economy of the engine in general is concerned, it is better to produce a long stroke, because a long stroke means a high velocity.

I have an apparatus which runs lights in the laboratory, and shortly I think I will have something which will be ready for practical application. I think I am not mistaken in believing that we are going to have very shortly a means at hand of producing twice as much electricity from coal as we can produce at the present time—provided I am not mistaken. This is subject, of course, to a test, but I am quite confident that it can be done. This is not, however, a subject which occupies me altogether. There are also other subjects.

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SALISBURY, December 9, 1893.

The Coal Trade.—Oil Gas Processes.

The position of affairs in the coal market has changed round to an opposite direction since the date of my last letter. At that time, and up to a fortnight since, great difficulty was experienced in obtaining proper supplies of coal. Orders were never refused, but the fulfillment of them was delayed on all manner of pretexts. The difficulty of getting trucks was the usual one, and it would almost seem that half the railway coal wagons in the country went off for a few weeks' rest to some unknown and inaccessible region. Every gas manager had to devote a large portion of his time to the unprofitable task of writing or telegraphing anywhere and everywhere in order to get a sufficient supply of coal to meet his wants from day to day. The reduction of gas supply had to be freely resorted to, and some announced that the valves would be closed during the hours of daylight. One or two had to shut up entirely for a few days, and I think that this is the first time in the history of our industry that gas manufacture has been limited for want of staple material. Now the gas manager is equally energetic in stopping supplies, being simply overwhelmed with the arrears of orders that come rushing in under the endeavor to discharge all that is due, and more if possible, before the inevitable drop from the panic prices of the last few weeks can occur. Gas people have been carefully impressed with the rule that orders can only be accepted at current rates; which is a very convenient restriction when prices are on the rise, but may

cut both ways, and the sellers do not fancy the idea of its selling in the buyers favor as well as in their own. If, in the anxiety of the moment, a chance order has been given at any time within the last three months, it comes tumbling in now. In many cases, small orders were so placed as a kind of second string to the bow, and perhaps forgotten. Possibly after two or three vain appeals they were discarded and other material ordered in their place. However that may be, they make their unwelcome appearance now.

The reason of this change will be obvious. As already indicated, both of the opposing parties were heartily tired of the struggle, yet neither were inclined to take a determined step towards its close. The miners were starving; the masters were losing capital, and outside there was a large and rapidly spreading circle of distress and loss of trade. It would scarcely be possible to hit upon a more efficient plan of injuring the National commercial prosperity. But the miners had said that they would rather starve than give in, and the masters felt that they could not retire from the position they had taken up without losing prestige by owning themselves in the wrong. At this stage, somebody thought of utilizing the Government. It was a very happy idea. Both parties, being in the position of inability to come up to time, had no objection whatever to being ordered to cease the combat, while the Government had an opportunity of rehabilitating itself in the eyes of the numerous body of spectators in all parts of the world, who had remarked upon the extraordinary spectacle of a particular section ruining the nation under the complacent indifference of the authorities that are supposed to look after its interests. The result was on the 17th ult., that a kind of trans parent farce was enacted, by holding a meeting of the representatives of both parties under the chairmanship of a provincial statesman nominated by the Government. After sitting for four and a half hours, the meeting agreed that work should be resumed at the old rate of wages, pending the formation of a Board of Conciliation. The probable result of the conference was a matter of general knowledge at least two days before it was held, so it was little better than a matter of form, and is not likely to have any marked effect on the future of the coal question, though it will be a convenient weapon to partisans of either side in the future. With the history of the past before us, it is simply ridiculous that a four months' struggle, capped off with an imperative message from the Government, should be necessary to emphasize the obvious lesson that labor cannot dictate to capital, and that capital cannot coerce labor. Whether the Board of Conciliation will be able to evolve a plan that will leave us in the possession of a steady and reliable coal supply, remains to be seen. As neither side have secured the ends for which they fought, it is to be hoped they will recognize that compromise is the direction in which to look for a settlement of their difficulties, rather than brute force. If a substantial advance in this direction has been made, the coal strike of 1893 will not be barren of useful results. But the benefit, if any, has been purchased at a terrible cost. It is impossible to portray the full extent of the suffering and loss that has been occasioned by this unfortunate dispute.

The high cost of coal and cannel has caused great interest in methods of making gas from other materials. Several processes are now under practical trial, but most of them appear to be directed towards the production of an enriching gas, rather than to the entire displacement of the present method of working. They seem to aim at turning out a gas of 50 to 100 candle power, that can be diluted to the desired degree with poor coal or with crude water gas. As the kinds of coal that are capable of yielding, without enrichment, a gas of 16-candle power or upwards are limited, and consequently high in price, a reliable process for raising 12 or 14-candle gas up to 17 or 18 would be a great help, particularly as the majority of our gas companies are bound under legal penalty to furnish gas of not less than 16-candle power. And this is the field that is at present being actively worked. Even with cannel at the cheapest, it has been found that the cost of another candle, *i. e.*, of raising the quality from 16 to 17 candles, is not less than 1½d. per 1,000 cubic feet. But if the new processes can be made a practical success, this figure will be lowered to something under ½d. A recent meeting of the Southern District Association of Gas Managers was devoted to the hearing of a lengthy paper on the subject of the Tatham or oxy oil process, read by Dr. Thorne, and to the discussion of the same in detail by Prof. Vivian Lewes and other authorities. This process is somewhat distinct from any characteristic novelty in the manufacture of gas, since its special feature is the admixture of oxygen to suitable proportions with high power oil gas produced in any convenient way. It may, in fact, be described as a double enrichment, or as a means of further enriching existing enriching material. This point may be better expressed by quoting the conclusions arrived at in Dr. Thorne's paper, which are as follows:

(1.) The addition of oxygen to oil gas (preferably while the latter is still hot), not only increases the value of the gas when it is burned *per se*, but also when it is used for purposes of enrichment.

(2.) Oxy-oil gas is a highly permanent gas, and when used as an enricher of coal gas, actually increases the stability of that gas.

(3.) Enrichment of coal gas by oxy-oil gas would cost about ½d. per candle per 1,000 cubic feet.

He also claimed that, whereas ordinary coal gas gives a lower result with the ordinary flat flame burners as generally used, than with the argand burner, the difference was not so marked with the enriched gas, and therefore that the latter was better suited for general consumption.

The discussion that followed the reading of this paper was chiefly directed to the cost of the "extra candle," and the ability of other processes to compete in this respect with the Tatham. Prof. Lewes questioned the correctness of the statement that the admixture of oxygen added materially to the value of the gas as an enricher. The Tatham process had been adopted by the Corporation of Huddersfield, and is now in actual operation on a fairly large scale, under the superintendence of Mr. Herring, Gas Engineer to the Corporation. Then there is the Young process, which has also passed beyond the experimental stage, having been adopted at Peebles and other gas works in Scotland, to which allusion has been made in previous letters. It will be remembered that the only residual remaining in the Young process is a dry coke, which is said to be easy of removal from the retort, and to have a high value as a fuel. A Mr. Laing has recently been describing another special process for making gas from oil, as devised by himself, before the Scottish Society of Arts. His apparatus comprises a still in which the oil is vaporized, a condenser for removing the heavier vapors and returning them to the still, and a superheater of special construction, in which the vapors that pass through the condenser are broken up and brought into intimate contact with a large area of red hot surface, and thus converted into a permanent gas. This set of plant may be used either for oil refining or for gas making. The condenser may be so managed as to retain oils of any desired specific gravity, or the process might be continued until nothing remained in the still but a hard coke, the residue having been, after repeated distillation, condensation and returning the heavier parts, entirely driven through the condenser and converted into permanent gas. But the author prefers to stop as soon as the contents of the still are converted into pitch. This product can be completely drained away from the still, without necessitating any chipping or raking out, and it has a greater market value than the coke. Mr. Laing has somewhat peculiar views on the subject of illuminating gas, and appears to have approached the matter as an oil refiner desirous of turning the residual gas to useful account, rather than as a gas engineer in search of cheap or of high quality gas. It is obvious that if the superheater is properly designed and constructed according to the work it is called upon to do, a good permanent gas can be made. But although pitch may be worth half as much again as coke in the market, the running off in a molten state is a matter of some risk and difficulty. Particularly at a high temperature there is risk of its firing when coming out into the air, and large cooling bays or chambers are necessary. The author describes a useful improvement in cocks that are used with viscid materials, or with those that solidify above atmospheric temperature, and are therefore liable to cause trouble by leaving a core of solid matter in the plug. He simply makes holes on one or both sides of the shell, and fits screwed plugs to the same. When the cock is in the position of "off" these plugs can be removed and the passage way through the plug can be scraped or cleaned in any convenient way. This suggestion is capable of useful applications in our retort houses and condenser yards.

Coal in Colombia.

Mr. C. F. Z. Caracristi, in a report on the coal deposits of Colombia, says:

Looking at the map of Colombia we see a great indenture on the Atlantic coast of the department of Cauca, formed by the Gulfo de Uraba, or Darian del Nord. Into this gulf flow the Atrato, Arboletes, Punta de Piedra and many other small streams. I consider the territory embraced within latitude 7° 30′ and 9° north, and longitude 2° and 3° 15′, meridian of Bogota, as containing the most promising coal deposits of the Atlantic coast of South America. The coal measures expose themselves from Cabo Tiburon, on the borders of the departments of Panama and follow around the gulf and shore, traversing the various rivers and entering into the department of Bolivar after coursing the Arboletes. From here the coal extends to the Rio Magdalena, following the geological base of the hills from the valley of the Atrato. On its way through

the department of Bolivar the coal is exposed when it crosses the Rio Sinu and Cannaletta.

The coal which I explored on the Uraba coast was, first, a large deposit which exposes itself about three miles from the mouth of the Rio Punta de Piedra. Here the inundations have washed a small canon through which the river flows, and on the banks of which may be found carboniferous outcroppings. Second, a large and well defined extension of the deposit of Rio Punta de Piedra on the right bank of the Rio Volcan at its confluence with Rio Arboletes, four miles from its point of emptying into the gulf. At this point the veins of coal are from 3 to 20 feet thick, and extend southward a distance of not less than 60 miles. Third, I examined the coal of the Atrato, but owing to the rise of that river was unable to learn, with any degree of precision, the nature or geological condition of the deposit. Fourth, I discovered large veins of coal on the Rio Sinu, and excellent coal on Rio Cannaletta.

In Cauca, there are over 20 veins of coal, anthracite, bituminous and lignite, all of which has more or less commercial value. In their whole distance along the Darian in Cauca and the shores of Bolivar to a point opposite Puerto de Colombia, the coal measures have a length of 260 miles with an average of 30 miles. This gives a square mileage of 7,800, or a coal area equal to that of Alabama.

At a distance of about six miles from the Rio Caiman, in a northwardly direction, the carboniferous strata showed a "pinched" condition, and are somewhat distorted and irregular, doubtless from the effect of recent volcanic dislocations. The same may be said of the coal measures where they cross the Rio Varacuarando, above Turbo, to the south.

On the Rio Arboletes and the Volcan the "droppings" are even more wonderful than those of Pennsylvania, or, in fact, any I have had occasion to examine during my professional career of over 13 years.

Following are the analyses of the coal of Uraba:

Sample from Arboletes.	Per Cent.	Sample from Punta de Piedra.	Per Cent.
Gravity, 1.62.....	...	Gravity, 1.81.....	....
Fixed carbon	41.50	Fixed carbon	77.52
Ash.	6.11	Ash.....	7.31
Volatile matter	50.33	Volatile matter.....	12.41
Water.....	2.06	Sulphur	.26
		Water.....	2.50
Total	100.00	Total	100.00
Color of ash, white alkaline; quality of coal, black lignite.		Color of ash, yellow; quality coal, anthracite; heating power	60.92
Coke.....	49.30		

The coal follows the coast line at a distance of from 3 to 40 miles. I would estimate the visible supply at not less than 18,459,200,000 tons in the department of Cauca and Bolivar alone.

The cost of mining the coal I place at about $2.10, as against $1.62 in Pennsylvania.

At a distance of two miles south of Santa Maria, at the base of the mountains I found the first coal cropping in the form of a vein of lignite, bearing with it cannel coal, which, upon development, I believe will be found to be a valuable deposit.

At Rio Fundacion, about 1½ miles above the abandoned village of the name, the coal measures assume a proper and healthy form, and exhibit large veins of coal for a distance of 6 or 8 miles up the river. The total distance from Santa Maria to Rio Fundacion is 70 miles, about 60 of which are on the coal measures. In the Val du Par, too, I discovered extensive beds of the best quality of cannel coal.

On the Petrale canon and on Rio Fundacion I entered into extensive excavations which proved the coal to exist in well defined veins, and the "hanging" and "foot" walls to be of healthy sandstone, which necessitated but little "timbering" in the working of the coal. These mines are extremely valuable, owing to the fact that they exist at a healthy elevation above the sea, are supplied with cold water from the glacier of Santa Maria, and are on navigable rivers and on the line of a railroad now under construction from the porte of Santa Maria.

The analysis of the coal of this region speaks for itself:

Fixed carbon.....	34.85 per cent.
Ash	7.35 "
Volatile matter.....	57.80 "
Total	100.00 per cent.

Will not coke, gives white ash, and is peculiar in the fact that it ignites under a heat of 270°.

The carboniferous measures of this region extend along the coast of Venezuela to the Lago de Maracaibo, where an English Company, headed by Sir Edward Barrington, of London, is now opening up the mines.

Mr. N. H. Humphrys on Two Papers Read at Last Meeting of the American Association.

Our English correspondent, Mr. N. H. Humphrys, of Salisbury, has the following to say, in the London *Journal*, about the papers read by Mr. J. A. P. Crisfield and Mr. F. B. Wheeler, respectively, at the last meeting of the American Gas Light Association:

There are two points in connection with the proceedings of the American Gas Light Association, as recently reported in the *Journal*, upon which I should like to offer a few remarks.

The first occurs in the paper on "The Rate of Purification,"[1] by Mr. J. A. P. Crisfield, in which the author deals with the volume of oxide and the quantity of gas passed per hour, and from those two elements deduces the contact time. He also states that the fewer the number of boxes, the better the results. This is a very indirect way of getting at the fact that not only must there be a minimum contact time, but also a minimum contact velocity. Assuming that the depth of the vessels remain at a fixed measurement, it follows that the fewer the number of vessels, the larger the area, and therefore the slower the contact velocity. On this point, Mr. Newbigging says (see "Handbook," p. 107): "The capacity or purifying power of the vessel is determined more by its superficial area than by its cubical volume;" and the capacity of the vessel is obviously the same as, or directly proportioned to, the volume of oxide spoken of by Mr. Crisfield. That the introduction of air or oxygen has so far reduced the cost of labor as to render the item of interest on capital invested in purifying apparatus by far the most important in the cost of purification, is quite correct; but at the same time it is necessary to recollect that such cannot be efficiently applied without a proper area of material, or, in other words, without certain limitations as to contact velocity. So that, in theory, the thinner the allotted volume of oxide can be spread, the better will be the result. Contact time is proportionate to the volume of oxide; contact velocity, on the other hand, is a function of the superficial area of the purifier.

But while theory indicates that the most economical method of purifying is to have the material in one mass, or, to use Mr. Crisfield's expression, to reduce the number of purifying vessels as low as possible, the practical consideration of how far it is safe to trust all one's eggs in one basket comes in. No gas engineer would go to bed happy, at any rate at this time of the year, knowing that the purity of his gas supply was dependent upon the satisfactory behavior of one mass of oxide, or even of two. Small summer makes may be left to a single layer; but when fluctuations of make and of temperature have to be contended with, one likes to have a good reserve. However large the area, many would prefer to have at least three beds in use. This leads up to another consideration, and that is the minimum thickness of a bed of purifying material that may be regarded as safe in practice.

Mr. Crisfield also overlooks the point that, apart from cheapness and efficiency, the question of nuisance and of loss of gas in changing purifiers comes in. Large purifiers have become the rule, especially in gas works situated in crowded localities, not merely because they are economical, or from a belief that they save money; but as a means of minimizing nuisance by reducing the number of changes. Even if they brought no economy with them, many would prefer to incur the extra expenditure represented by the additional interest on capital, for this reason.

The second point comes in the paper on "Mathematical Analysis of Photometrical Observations,"[2] by Mr. F. B. Wheeler, which contains an ingenious suggestion for the investigation of conflicting experiments. But it appears to me to be applicable only to the results of observations upon one sample of gas which was known to remain constant throughout the series. In the example cited of the results of tests taken on 12 consecutive days, it appears that not only were 12 different samples operated on by the engineer, and that all these samples may possibly have varied in quality, but there is nothing to show that the gas examiner had anything in the way of similar samples. The gas might have varied from hour to hour, and if the engineer operated at one time of day and the examiner at another, the results would necessarily vary. Probably such was the case in the present instance, because on one occasion the examiner records a result nearly 2½, and on another 1½ candles higher than the engineer; while on a third he is 1½ candles lower. These three items contribute four-fifths of the sum of V^2; and it seems more reasonable to suppose that they are due to fluctuations in the quality of the article tested rather than to experimental errors. If the testing station was some distance from the works, it is only in accordance with the usual experience to suppose that the results arrived at by the examiner would exhibit a greater degree of variation than those obtained at the works.

1. See JOURNAL, Nov. 6, 1893, p. 653. 2. See JOURNAL, Nov. 6, 1893, p. 656.

Coke as a Domestic Fuel.

The *Jour. Soc. of Arts*, speaking on the use of coke for heating, cooking and for firing steam boilers, says :

Two causes have retarded the generalization of the use of coke in the heating of apartments. In the first place, the absence of heating apparatus in which coke might be burned economically ; and secondly, its dearness as compared with coal. On the other hand, the increased impetus given to the consumption of coal gas, through its application to cooking and motive power, with the diminution of coke consumption on account of the extended use of regenerative furnaces in gas works, has caused stocks of coke to accumulate. The managers and engineers of Belgian gas companies organized competitions of heating appliances especially designed for utilizing coke, one of the most successful of which competitions was that of the Association des Gasiers Belges in 1887. This Association lately instituted a fresh competition, in order to judge of the progress accomplished, and to bring the results prominently before the public. The jury, presided over by M. Depaire, professor of chemistry at the Brussels University, with Dr. Janssens, chief inspector of the Brussels Hygiene Service, as vice-president, was composed of men of practical knowledge and experience. A sum of 10,000 francs ($2,000) was set aside for recompensing the exhibitors of the best appliances, which were classed under the following heads: (*a*) open fireplaces ; (*b*) closed stoves for *appartements ;* (*c*) closed stoves for public buildings ; (*d*) hot air stoves ; (*e*) portable foot warmers ; (*f*) cooking stoves ; (*g*) bakers' ovens ; (*h*) special furnaces for heating by hot water or steam ; and (*i*) furnaces for steam boilers and other industrial purposes. These classes it was afterwards found necessary to subdivide into series, on account of the diversity of the 73 appliances sent in for competition.

The fireplaces and stoves for domestic use were tested in eight rooms of various size, in a dwelling house placed at the disposal of the committee by the Gas Company of Saint Josse-ten-Noode, a suburb of Brussels. Each appliance was kept under fire for at least a fortnight, the consumption of coke being noted with the greatest care, and the results tabulated under the heads of "Hourly consumption in normal working," and "Hourly consumption *en veilleuse* (damped down)," being the mean of 16 observations in the former case and 15 to 20 in the latter.

When working *en veilleuse* in continuous combustion stoves—*i. e.*, those provided with a feed chamber that may be closed hermetically—the air admission may be regulated so as to maintain the fire with a very small quantity of fuel—*i. e.*, from ½ to ¾ of a cubic decimeter (32 to 48 cubic inches) per hour. As the fire is fed in accordance with the consumption, it may smoulder for a very long period, from 24 to 48 hours, without any danger to the health, since the gases are always taken off by the chimney, and also without fear of conflagration, because there is no possibility of the smallest particle of fire escaping into the room.

The coke for each series of heating apparatus was of the same origin and composition, and the regularity of the fire was carefully noticed. Conformably with the dictates of hygiene, there was no damper in the uptake flue, the intensity of the fire being entirely regulated by the admission of air under the fire bars. Careful observations were made whether this regulating was easy and certain—*i. e.*, whether the fire preserved, without appreciable variation, the intensity given to it; whether it gave out deleterious products or not ; whether it became red hot or not on the outside ; and whether it was possible to quickly reduce the fire to a moderate intensity by merely moving the regulator or slide for admitting air. Notice was also taken whether the ashes might be easily removed, or whether they formed a compact clinker adhering to the side of the fire box. In this manner it was possible, without further examination, to eliminate defective stoves, etc.

The construction of each appliance was studied in detail as to strength, tightness, ease of taking to pieces, and elegance. In the case of apparatus for heating large buildings, hot air stoves, and special furnaces for heating water or generating steam, the jury first studied the drawings and the preliminary examination sufficed to cause the rejection of such appliances as did not fulfill the conditions of the programme. The stoves, etc., were then examined as regards their calorific yield or useful effect, expressed by the ratio of the quantity of caloric available for heating a given space to the total quantity of heat produced by the combination. The direct appreciation or estimation of the quantity of heat utilized presents insurmountable difficulties ; but it might easily be deduced from the relative quantity of heat carried away by the products of combustion. This quantity of heat was calculated by means of the following data : (*a*) the temperature of the gases generated by the combustion—temperature observed inside the uptake by a thermometer placed at an equal distance from the hearth for all appliances of the same class ; (*b*) the quantity of carbonic acid, and that of carbonic oxide if there were any, contained in the products of combustion.

These gases were collected by a tube inserted in an aperture made in the uptake flue, opposite the thermometer mentioned above. The content by weight of carbonic anhydride was determined by drawing a predetermined volume of gas through four tubes with caustic potash, followed by a tube containing sulphuric pumice stone, the products of combustion having been previously deprived of their water by passing through a tube with weighed sulphuric pumice stone. The content by volume of carbonic oxide was determined, by means of a Bunte test tube, by absorption with the aid of cuprous chloride of ammonia, after elimination of the carbonic acid and oxygen.

In the tests carried out on the stoves, etc., which were awarded a prize, no appreciable quantities of carbonic oxide were found to exist in the products of combustion. A considerable number of prizes were awarded to stoves in which the combustion was considered to be satisfactory.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At the annual meeting of the Oneida, (N. Y.) Gas Light Company, the following officers were chosen : Directors : Messrs. S. H. Farnam, D. H. Walrath, George Berry; H. S. Klock and W. E. Northrup ; President, W. E. Northrup ; Secretary and Treasurer, H. S. Klock. The Company enjoyed a fairly prosperous year, and it was voted to declare a dividend of 3 per cent., payable on and after the 10th inst.

The Directors of the newly incorporated Nanticoke Gas Company are Messrs. M. W. Morris, J. N. Thomas and Thomas Griffith, of Pittston, Pa., and W. D. Beers and Frederick Turner, of Wilkes-Barre, Pa. It is capitalized in $25,000. Nanticoke is in Hanover Township, Luzerne County, Pa., and is located in the Wyoming Valley, on the north branch of the Susquehanna river, at a point eight miles west southwest of Wilkes-Barre. It is a great anthracite coal producing center, and has a population of about 8,000.

The Milwaukee Gas Light Company has donated 100 tons of coke to be distributed among the deserving poor of that city. The fuel will be delivered upon orders issued by the Chief of Police.

A correspondent at Greensburg, Pa., informs us that the employees of the New York and Cleveland Gas Coal Company, at Turtle Creek, Pa., have at last gone to work after an idling spell which lasted for months. They went to work under the new scale of 55 cents, or 5 cents less than the Pittsburg district scale, which includes all the mines of the Pittsburg and Monongahela seam.

The Board of Gas and Electric Light Commissioners of Massachusetts gave a hearing some days ago in the Chelsea (Mass.) City Hall, on a petition of the Chelsea Gas Light Company that the Board revise its action of November 10, that the price of gas in Chelsea after January 1st shall not exceed $1.65 per 1,000 cubic feet. Mayor Converse and City Solicitor D. E. Gould were present on behalf of the City of Chelsea, and President William G. Peck, Treasurer, Moses and Lawyer D. F. Kimball represented the Gas Company. The question of allowing a continuance of charging a gross price, which is an important one to all gas companies, was one of the points brought up. Chairman Wheelwright opened the hearing by reading the petition recently made to the Commissioners by the Gas Company. He said it was mandatory under the law for the Commissioners to give one rehearing always upon a petition of this kind, and no more. The Company's petition said that the reduction ordered would necessitate the reduction in the Company's dividends from 5 to at least 4 per cent. President Peck said the Company desired a net price per 1,000 cubic feet for prompt payment, as well as a reconsideration of their action of November 10th. Any reduction that might be made, unless it be so much as to make the gas and electric lights as cheap as kerosene oil for lighting, would not increase the use by small householders, of which Chelsea was largely made up. The reduction recommended by the Board would cause a loss of $7,384, and if that went into effect their earnings would not be more than enough to cover depreciation, leaving nothing for maintenance of plant, street repairs and incidentals. The order, he said, also took away a privilege which the Company had enjoyed for years, having a gross price and making a reduction of price for prompt payment. Commissioner Schaff asked President Peck if he thought it was the intention of the law creating the Board that the Board should make the price of gas for a part of the time and a Gas Company for the rest of the time. He replied that he understood the Board had full power to fix the price. The Commis-

sioner askec Mr. Peck if he did not think that if the Board fixed the price for the first ten days of the month, and the Company was allowed to fix it for the other twenty, as was practically the effect when a gross price was allowed, the Company was in reality making the price more than the Board? Mr. Peck made no direct answer. Mr. Lamson, of the Worcester Gas Light Company, was present, because he said he understood that this was the first time the Board had considered the matter of gross and net prices, which was a most important one to all Gas Companies in the State. He was called upon by the officers of the Chelsea Company to give some expert testimony, but objection being raised by Commissioner Schaff, because the Board was to hear his case at Worcester soon, he declined to testify. President Chamberlain, of the Cambridge Gas Light Company, was present, and gave some testimony on general gas matters. City Solicitor Gould, for the city, said no new evidence had been introduced, and he had heard no valid reason why the Commission should reverse its decision. The Company, under good management with the reduced price, he felt assured, would increase its business, and he hoped the decision would stand. The Commissioners took the matter under advisement.

THE Louisiana (Mo.) Electric Light Company was absorbed on the 21st inst. by the Carbon Light Company, of that city, which has hitherto been operating a combined gas and electric lighting plant. The machinery of the new purchase will be removed to the gas works buildings, and considerable money will be expended on betterments. The officers of the Carbon Light Company are: President, John H. Lucas; Secretary, Wm. T. Johnson; Superintendent, B. S. Reynolds. We are glad to welcome the latter back to the active ranks, for some years ago he was in charge of these works at Louisiana, but resigned the position to engage in the railroad business.

MR. JOHN CORSCOT, Treasurer and Secretary of the Madison (Wis.) Gas Light and Coke Company, has just been elected Mayor of that city. They can't get along without the gas men, we tell you.

THE Detroit Gas Company is printing the following displayed advertisement in the local papers: "*To gas consumers*—The Detroit Gas Company is in possession of information that a party representing himself to be a gas expert is canvassing the city and pretending, for a consideration, to test the meters of this Company. You are hereby notified that only the Gas Company and the properly accredited agent of the city (the City Gas Inspector) has authority to remove and test meters. The party above referred to will be prosecuted if found interfering with the Company's meters. Consumers are further notified that they will be held responsible for any damage that may occur to meters while in their possession if they permit them to be interfered with by unauthorized persons.

THE sale of the Citizens Gas Company, of Tamaqua, Pa., to Philadelphia capitalists is reported. The new owners were to take possession on January 1, 1894, and it is also likely that the Company will engage in the electric lighting business, both on arc and incandescent lamp account.

MR. WILLIAM REID, SR., who had been in the employ of the Milwaukee Gas Company for 25 years, is dead.

MR. GEORGE W. BORDENS has been appointed Application Clerk in the Philadelphia Gas Bureau's branch office at Germantown, and assumes the duties thereof to-day. The position is a new one, and it ought to be of much convenience to the residents of the district.

THE Board of Trustees of Alameda, Cal., have adopted the following ordinance: "*Section* 1. Except where otherwise ordered by this Board, all water pipes and conduits in said city shall be laid on the northern side of streets running in an easterly and westerly direction, and on the westerly side of streets running in a northerly and southerly direction. The pipes and conduits must be laid under the roadway of the street 4 feet from the curb line of the street, and the top of the conduits and pipes must be at least 3 feet below the top of the curb line of the street. All gas pipes, unless so otherwise ordered, must be laid on the opposite side of the streets from said water pipes. Where pipes or conduits cross the line of gas pipes they must be laid so as not to interfere with such gas pipes. *Sec.* 2. Any person violating any of the provisions of this ordinance shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine not exceeding $100, or by imprisonment in the jail of Alameda county, not exceeding 50 days, or by both such fine and imprisonment. *Sec.* 3. This ordinance shall take effect and be in force from and after its passage."

AT a meeting of the Directors of the New Bedford Gas and Edison Light Company, of New Bedford, Mass., Charles H. Lawton was elected a Director to fill the vacancy caused by the death of William T. Rotch. The Company also declared a dividend of 1½ per cent., payable January 15, to stockholders of record December 18.

RECENT issues of the Newark (N. J.) newspapers say that the Newark Gas Light Company has settled a civil suit against saloon keeper Paul Abrell, of No. 9 Bowery street, Newark, in March, 1893, by accepting from him about $1,000. The settlement was made for gas consumed by Abrell, who it is claimed bye-passed the meter. In round numbers the Company claimed Abrell had used $3,000 worth of gas, but suit was brought for one-half that amount. On December 21st Abrell was arrested on a capias from the Prosecutor's office, under an indictment from the grand jury, in which he is charged with the larceny of 50,000 cubic feet of gas. Defendant asserts he is the victim of a conspiracy.

ON and after January 1st the net price of gas in Chicago will be reduced to $1.15 per 1,000 cubic feet, under the terms of the agreement entered into something like two years ago with the city. This, of course, only affects the use of gas for illuminating purposes, the price for gas used for cooking, heating and power purposes having been fixed by the agreement at $1 per 1,000.

IT is no wonder that electric light finds a fairly good foothold in some situations, and one of the latter is in evidence at Healdsburg, Cal., where the gross gas rate is $5 per 1,000 cubic feet, and the net $4.50. It is true that the place is a small one, with the population numbering about 3,000, but the gas output per annum (perhaps 600,000 cubic feet) is far below what it should be. Of course the high rate is largely responsible for this condition of affairs, and it is also responsible for the spread of incandescent electric lighting, which has been winning many patrons of late in Healdsburg. The proprietors of the Gas Company, however, have at last determined to apply the proper remedy, in that a reduction of the selling rate to $3.50 per 1,000 cubic feet has been ordered. We know that gas making materials are expensive in the Healdsburg district, but it is equally true that the factors which enter into the manufacture and distribution of electric currents are just as costly, wherefore the situation as between the gas and the electric suppliers is the same at Healdsburg as it is anywhere else. In that light economy and efficiency are the deciding points.

WE understand that Messrs. Apple and Elyea, of Lima, Ohio, have secured control of the gas and electric lighting plants at Le Roy, N. Y.

THE Cincinnati *Gazette* recently had the following to say about the proposed consolidation of the gas and electric lighting interests of that city: "The absorption of the Cincinnati Electric Light Company by the Cincinnati Gas Light and Coke Company has been a subject of considerable interest and speculation to frequenters of Third street for some months past. It was known that on December 18th the Directors of the Cincinnati Gas Company had held a meeting at which the regular quarterly dividend had been declared. This led to a report that arrangements for the consolidation of the two companies had been completed. The matter was considered by the Directors, but no definite action was taken. It is about understood, however, that when the consolidation does take place there will be one share of gas stock issued to absorb each 20 shares of electric light stock. As the par value of gas stock is $100 per share, and that of the electric light stock but $5, this is a virtual exchange of stocks on a par basis. However, gas stock is more valuable than electric light stock, selling in the market at 199, while electric light was obtainable until December 19th at about $1.75 to $1.80. When it became known upon what basis the consolidation would be effected a better demand for electric light stock sprang up, and it was bid for at $1.87; but there was no change in the market price of gas stock. Under the original charter of the Gas Company, it could not own or operate an electric light plant, so the Cincinnati Electric Light Company was organized with the intention of in time being absorbed by the Gas Company. General Hickenlooper recommended that each gas stock holder hold a corresponding amount of electric light stock. This was in 1889. At the time a regular quarterly dividend of 2½ per cent. on gas was declared, in cash, and an extra one of 2½ per cent. This was given to the stockholders in stock of the Cincinnati Electric Light Company at 50 cents on the dollar, which was recognized as par, the Gas Company paying the money to the new corporation. Soon afterwards a further issue was made of $300,000, which was given to the stockholders at $1.75. Considerable of the stock taken at the latter figure has been sold at a sacrifice; still, there are many holders of stock

who purchased theirs at that figure, or better, for it was their belief that as the Gas Company had issued it at that price it would ultimately take care of it at that, or better. Now it seems that their expectations are to be realized. Last winter the proper legislation was secured, authorizing the consolidation or absorption by the Gas Company of the Cincinnati Electric Light Company, or of any other, or the erection of its own electric light plant. Since then arrangements have been in progress for the consolidation, and it is now only but a matter of a short time until the union will occur, though it is positively announced that they have not been completed yet. There have been no arrangements completed between the Gas Company and the Edison Electric Light Company, as many believe there have been, but both claim that the other would be very willing for such an arrangement."

MR. DAVID MOORE, who has acted as Treasurer of the Salem (Mass.) Gas Light Company since January 1st, 1865, has handed in his resignation, the same to date from December 23d. A special meeting of the Directors was called to consider the same, and it was accepted. A special meeting of the shareholders to fill the vacancy was called for Thursday last, but we have no advices as to who was chosen.

FINAL papers for the purchase by the town of the property of the Middleboro Gas and Electric Light Company have been signed. The price paid was $63,000, and bonds amounting to $75,000 have been issued by the town to pay for the works, and to complete some improvements on the plant.

MR. JUDD A. WANN has been appointed Receiver of the Sun Vapor Street Light Company, of Canton, Ohio. The Company is capitalized in $175,000, and its liabilities are put at $300,000, with assets amounting to perhaps 65 per cent. of that sum.

WE understand that a gas works will be constructed at Salamanca, N.Y., the authorities having granted a franchise for the operation of such to the projectors of the Randolph Gas Company. Salamanca is a borough in a similarly named township of Cattaraugus county, N.Y., and is situated on the Allegheny River at a point 46 miles east south east of Dunkirk, 108 miles southwest of Rochester and 34 miles east of Jamestown. It is an important point in the main line of the Erie Railroad, has several sawmills and tanneries, and has a population of about 4,200.

THE gas works at Huntington, Long Island, are in active operation, and the people seem to be pleased with the initial service.

S. F. WALKER has petitioned the City Council, of Salt Lake, Utah, for a franchise to construct and maintain a gas and electric light works in that city. The franchise provides that the grantee, his successors and assigns, shall, and by his acceptance of the rights and privileges granted, agrees with the city to furnish manufactured gas to the citizens of Salt Lake at a price not exceeding $2 per 1,000 cubic feet, and natural gas not to exceed 30 cents per 1,000 cubic feet; and furnish electric light at a price not to exceed 1 cent per hour for each 16 candle power lamp, and a proportionate charge for all lamps of increased candle power, and for all arc lamps of 2,000 candle power not to exceed $10 per month for 12 o'clock service, and $15 per month for all night service; to furnish for the streets, highways and public places for the city, in any desired number, at a price not exceeding $10 per month for each arc light of 2,000 candle power for all night services, each night in the week; to furnish the City Council Chamber, city offices and Public Library with the necessary current for light continuously during the life of the franchise, free of charge.

A CORRESPONDENT at Passadena, Cal., incloses the following: "Gas in this city is gaining ground as a useful agent for lighting, heating, cooking and other purposes. The *Evening Star* is printed by means of a gas engine, and all the machinery in the Throop Polytechnic Institute, as well as the great Mt. Lowe Railroad, are operated by gas power; also, the two machine shops and Wakeley's works, of Passadena. In consequence of the popularity of the gas for various purposes, and the great demand for an increased supply, the local Company feels warranted in putting down 4 miles of pipe for street mains, which will be laid on streets where applications from the greatest number of consumers are shown. The largest will be a heavy 8-inch main up Raymond avenue to the Opera House, from which branches will extend east and west to the principal streets, and from thence past Hotel Green a 6 inch pipe will be laid, and so connected as to give an ample supply to both east and west sides of town, thus more than doubling the delivering capacity of the works."

A FIRST session Superior Court jury, Boston, returned a verdict for the defendants, on December 21st, in each of four actions of tort against the Boston Gas Light Company, by John Carmody and three others, members of Carmody's family, who claimed an aggregate of $20,000 for personal injuries resulting from the escape of gas into their tenement, No. 1 Thorn street, on February 19, 1892.

"OBSERVER" forwards the following from Boston: "The Directors of the Lowell Gas Light Company have voted to reduce the price of gas 10 cents, making it $1 per 1,000 to all who pay promptly, this price to take effect February 1st, 1894. This is the lowest price in New England for an inland city. But for the long distance from tidewater and the high freight rate on coal, of course the Company could sell its product at a much lower rate. The reduction of price is not necessitated by the competition of the electric light company, nor by any public agitation, but is given, as similar reductions have been given before, because the Company is so prosperous that it can well afford to make this concession. There is no fear either that the reduction of price will interfere with the liberal dividends that the Company is in the habit of paying its shareholders."

THE Visalia (Cal.) Gas Light and Heat Company has decided to put in a Thomson-Houston incandescent electric light machine equal to the generation of current for the maintenance of 1,000 lamps of 16 candle power each. Superintendent Winkler says the Company's gas output steadily increases.

The Separation of Oil from Exhaust Steam.

Engineering Record remarks that within the past ten years there have come into extensive use various devices for application to exhaust pipes, having for an object the separation of oil contained in the steam delivered from the engine. These devices have followed closely the introduction of separators in the main steam pipes for the removal of entrained water and the delivery of dry steam. It has been thought that oil separators were useful so far as they operated, for everyone admits that it is extremely desirable to remove from exhaust steam the oil which contaminates it, such steam being commonly employed for some heating purpose where the presence of oil does more or less injury. Though useful, it has been thought that their utility was limited, since it was believed that they fail to remove a considerable portion of the objectionable material. There are no less than a dozen different designs of oil separators which can be bought in the market, and many of these have met with a large sale. There are few, if any, of the new steam plants which make pretensions to a complete equipment, that do not have some design of oil separator; from which it would be inferred that there is a general belief among steam engineers that the device is essential to good work.

Whatever opinions may have been held in the past regarding the possibility of separating oil from steam, recent investigations, which we hope to fully describe in a future number, have proved that by suitably arranged devices a very large proportion of the oil discharged from the engine cylinder can be intercepted and withdrawn mechanically from the steam. Doubtless a small amount of oil may be so thoroughly atomized by the action of the steam that it becomes practically gasified, a condition from which it is impossible to be recovered by any mechanical process. This part of the oil must necessarily pass on with the steam, and it will be found in the water of condensation, or in the liquid which the steam is employed in heating. The operation of an oil separator depends largely upon the fact that the particles of oil are heavier than the medium which surrounds them, and they are less readily deflected from their course than the steam. In this respect the particles doubtless act in the same manner as globules of water mechanically held in suspension, and it may be that the particles of water which abound in exhaust steam form a nucleus around which the oil collects, and which assist in the mechanical separation. The interposition of deflecting plates in the current of steam, which force the contents of the pipe to take a circuitous course through the separator, provides a means of intercepting the heavy particles, whether of oil or of water, and when once collected they can readily be removed.

If separation of oil is desired, in the case, for example, of steam heating plants where the use of the water of condensation for feeding the boilers is the principal object sought, it is certainly better to introduce a separator between the engine and the heating main, and rid the steam before hand of all the oil which it is possible to remove, than it is to do without a device of this kind and endeavor to purify the water before it is supplied to the boiler.

The Market for Gas Securities.

The market for city gas shares continues dull, restricted and weak, particularly in respect of Consolidated, which opened to day (Friday) at 124 bid, offered at 125½, a drop of 3 points in the bid price from the figures of last week. Yesterday 218 shares were sold on the Exchange at the even rate of 125. We know of no reason why the shares should be selling at these figures, unless it be that some of those who purchased at the panic prices of last summer are taking their profit. Then, too, there is the possibility that others, apprehensive of what the Legislature will do in respect of gas rates, are taking time by the forelock. Other city shares are fairly steady, especially Standard preferred, a small lot of which changed hands at 77½. The Brooklyn situation is quite uncertain, but it looks that the election of Mr. A. E. Orr to the Presidency of the Metropolitan Company means an approach to consolidation. All classes of Brooklyn gas shares are a shade weaker, and we imagine they will go lower; still old Brooklyn at anything under 115 seems to be worth while trying for. We note a sale at auction of 50 shares Beckton Construction Company, preferred, at 79½. Chicago gas sold down to 59 and a fraction at the opening to-day, but supporting orders forced the price back to 60½ and ¾. Bay State is weaker, at 13½ to 14, and Baltimore Consolidated is returned at 54 to 54½.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 Wall St., New York City.

January 1.

☞ All communications will receive particular attention. The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	124	125½
Central	500,000	50	90	95
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	190	195
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	145	150
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	80	95
" Bonds	150,000	—	—	100
Richmond Co., S. I.	346,000	50	50	65
" Bonds	20,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	—	32
Preferred	5,000,000	100	—	77
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	110	—
Citizens	1,200,000	20	57	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	25	40
Fulton Municipal	3,000,000	100	130	—
" Bonds	300,000		103	—
Peoples	1,000,000	10	80	—
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	—	140
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	146	—
" Otfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	130	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	13½	14
Income Bonds	2,000,000	1000	40	—
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	77	79
2d " " "	3,000,000	1000	57	58
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company.	25,000,000	100	60½	60¾
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅞	81½
Consumers Gas Light Co., Jersey City	2,000,000	100	—	30
Bonds	600,000	1000	—	85
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal			—	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt	11,000,000	100	54	54½
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.— 1st Mortgage			45	—
East River Gas Co., Long Island City	1,000,000	100	—	—
Bonds	500,000	100	86	87

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DIVIDEND NOTICE.

STANDARD GAS LIGHT CO. OF THE CITY OF NEW YORK, 71 BROADWAY, NEW YORK, Dec. 13, 1893.

The Board of Directors have this day declared a dividend of one (1) per cent. on the Preferred Stock of this Company, payable on Jan. 2d, 1894, to stockholders of record at 3 o'clock P.M., Dec. 20th, 1893.

Transfer books will be closed from 3 o'clock P.M., Dec. 20th, 1893, to 10 o'clock A.M., Jan. 3d, 1894.

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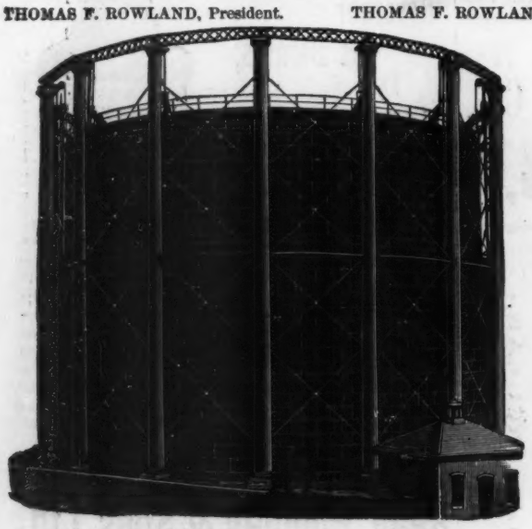

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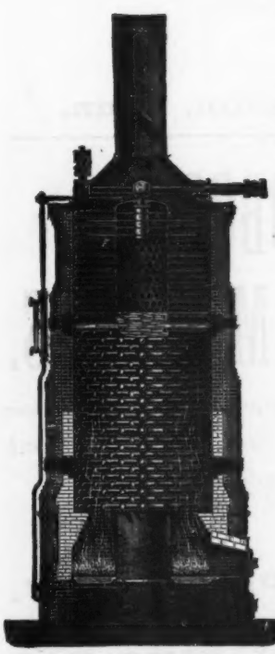

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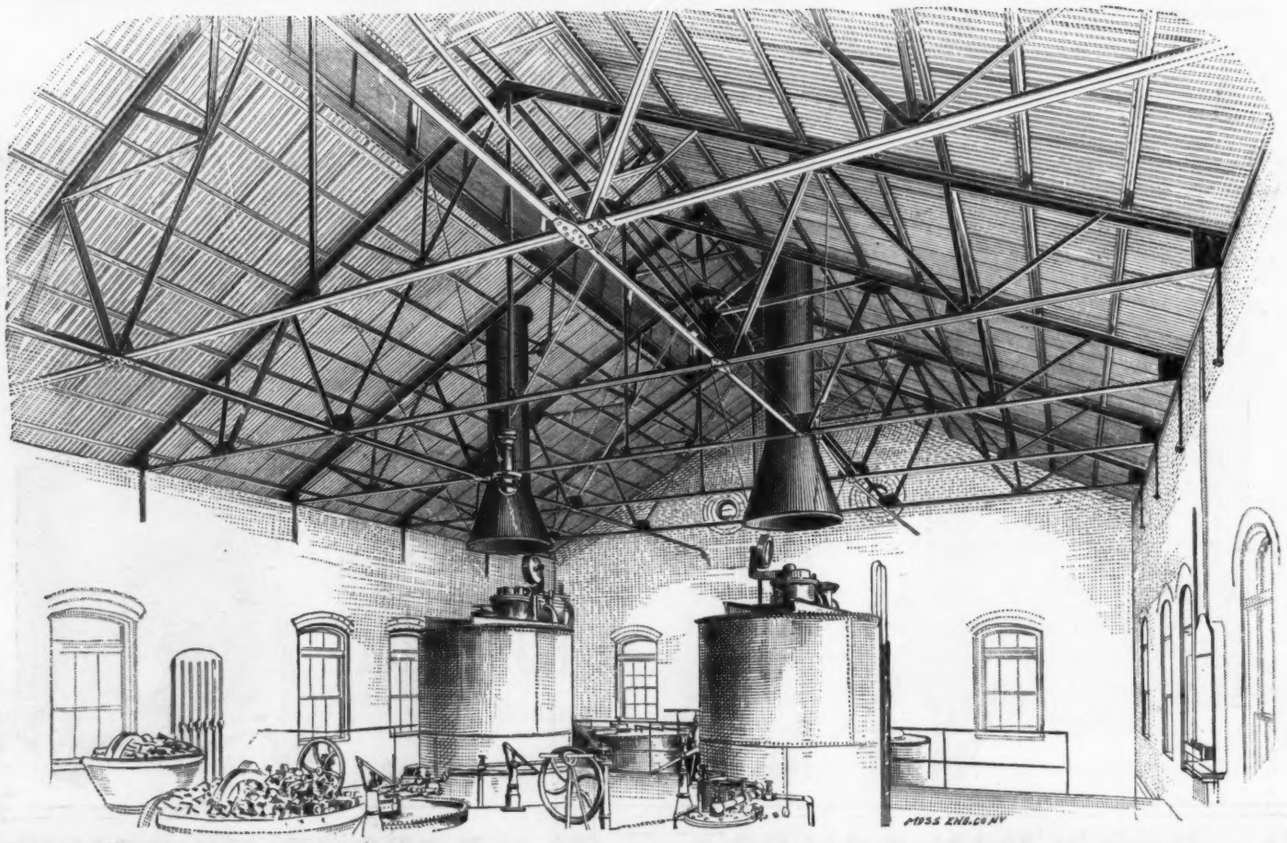

The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for the Providence Gas Light Company, at Providence, R. I. The building is 40 ft. in width by 100 ft. in length, the side walls being of brick and the roof being entirely of iron—that is, iron trusses and iron purlins covered with corrugated iron. The building is ventilated by our Improved Ventilator, extending the full length of the roof, with side shutters opened and closed by cords from the floor. No woodwork is used in any way about the construction of the building.

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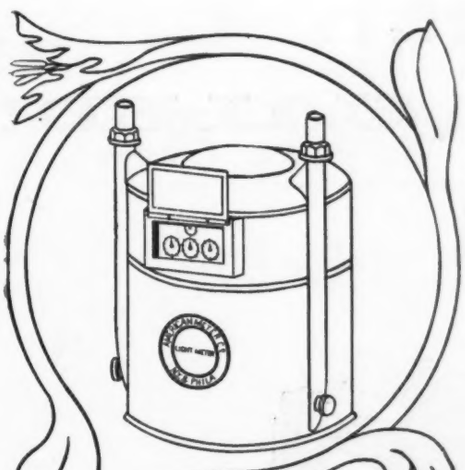

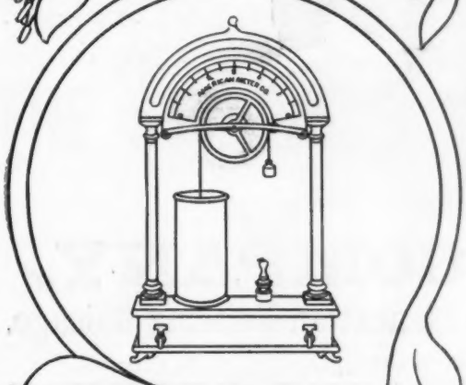

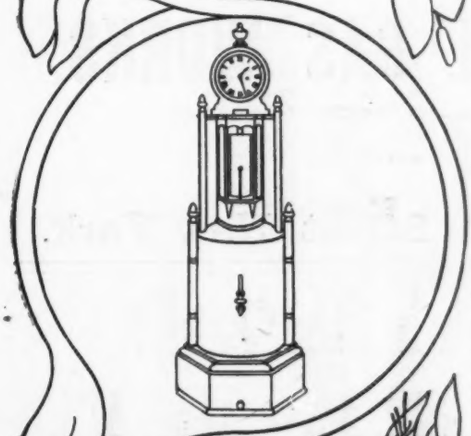

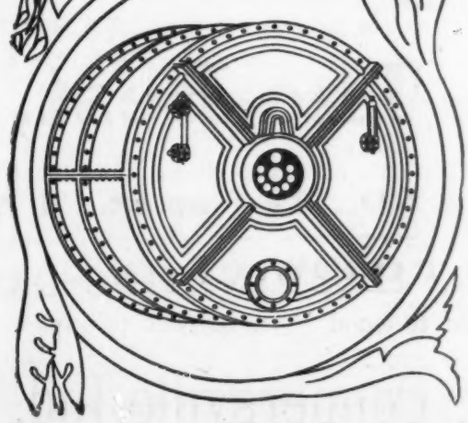

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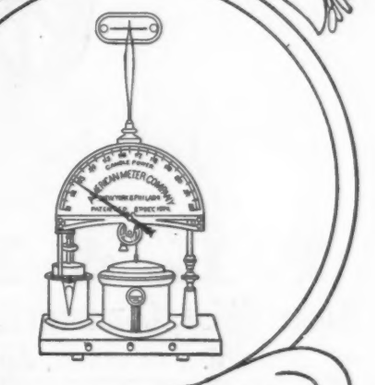
PUBLIC LIGHTING TABLE.

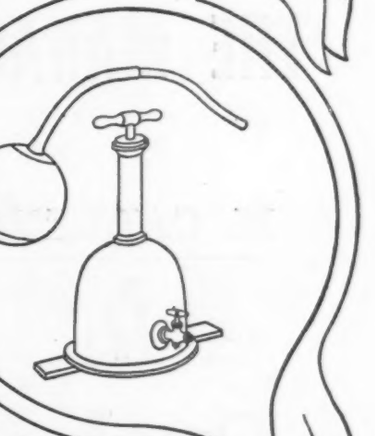
JANUARY, 1894.

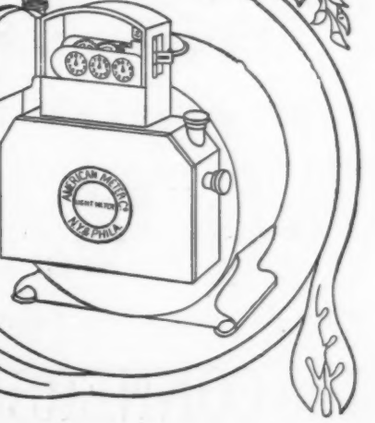
Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Mon.	1	5.20 PM	4.30 AM	4.30	6.30
Tue.	2	5.20	5.30	4.30	6.30
Wed.	3	5.20	6.20	4.30	6.30
Thu.	4	5.20	6.20	4.30	6.30
Fri.	5	5.20	6.20	4.30	6.30
Sat.	6	5.20 NM	6.20	4.30	6.30
Sun.	7	5.20	6.20	4.30	6.30
Mon.	8	5.20	6.20	4.40	6.30
Tue.	9	5.20	6.20	4.40	6.30
Wed.	10	5.20	6.20	4.40	6.30
Thu.	11	8.30	6.20	4.40	6.30
Fri.	12	9.30	6.20	4.40	6.30
Sat.	13	10.30	6.20	4.40	6.30
Sun.	14	11.40 FQ	6.20	4.40	6.30
Mon.	15	1.00 AM	6.20	4.50	6.25
Tue.	16	2.10	6.20	4.50	6.25
Wed.	17	3.30	6.20	4.50	6.25
Thu.	18	4.40	6.20	4.50	6.25
Fri.	19	No L.	No L.	4.50	6.25
Sat.	20	No L.	No L.	4.50	6.25
Sun.	21	No L. FM	No L.	4.50	6.25
Mon.	22	5.40	7.30 PM	5.00	6.25
Tue.	23	5.40	8.50	5.00	6.25
Wed.	24	5.40	10.00	5.00	6.25
Thu.	25	5.40	11.10	5.00	6.25
Fri.	26	5.40	12.10 AM	5.00	6.25
Sat.	27	5.40	1.20	5.00	6.25
Sun.	28	5.40 LQ	2.20	5.00	6.25
Mon.	29	5.50	3.30	5.05	6.15
Tue.	30	5.50	4.30	5.05	6.15
Wed.	31	5.50	5.30	5.05	6.15

TOTAL HOURS LIGHTING DURING 1894.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	244.10	January	423.20
February	195.30	February	355.25
March	206.20	March	355.35
April	169.40	April	298.50
May	162.10	May	264.50
June	135.40	June	234.25
July	146.30	July	243.45
August	162.20	August	280.25
September	174.10	September	321.15
October	211.20	October	374.30
November	221.00	November	401.40
December	245.30	December	433.45
Total	2274.20	Total	3987.45







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Having been in use twenty-five years, it speaks for itself, and stands

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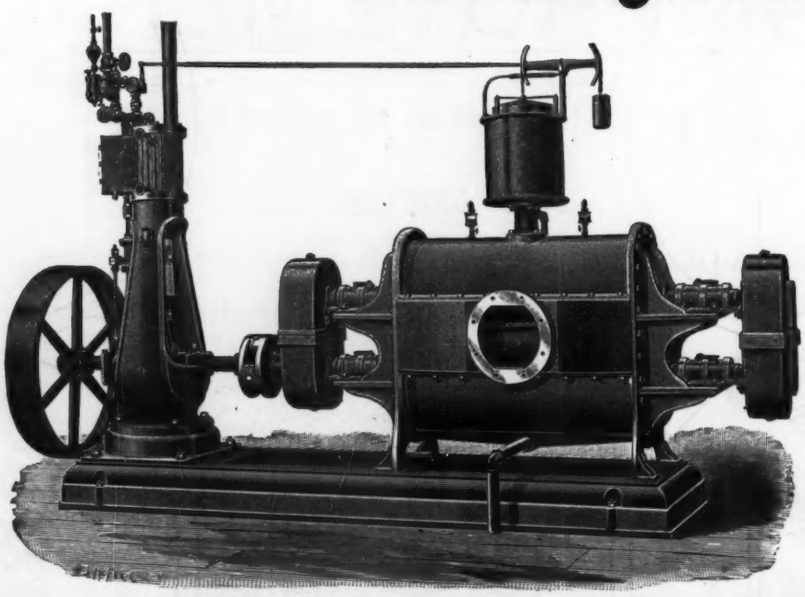

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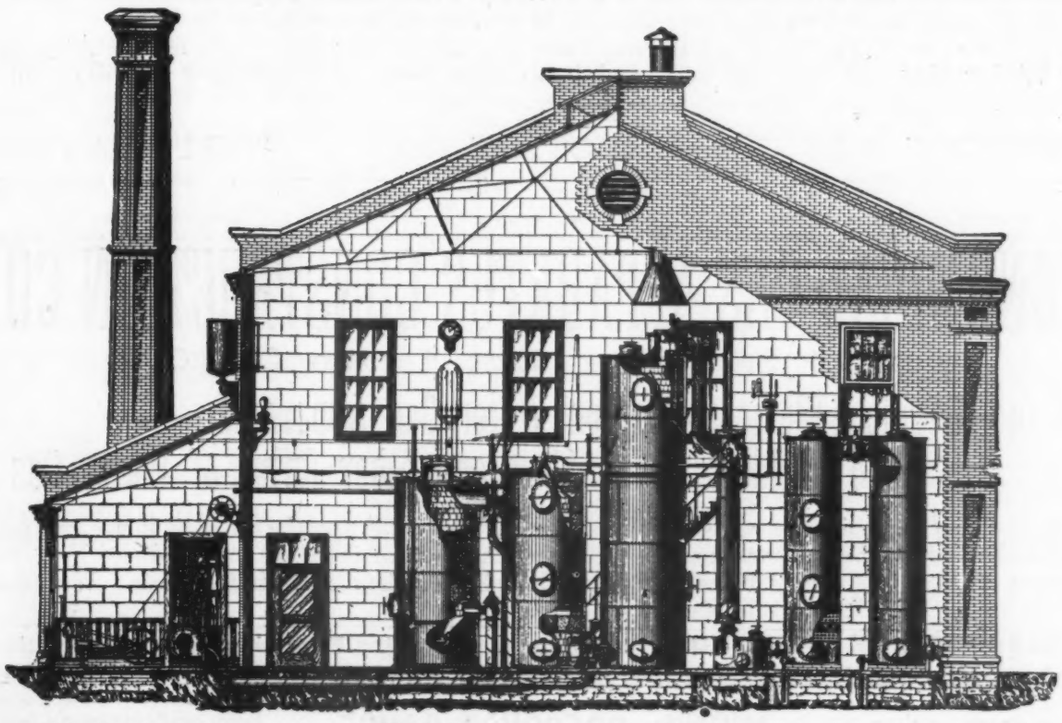

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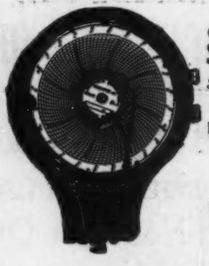

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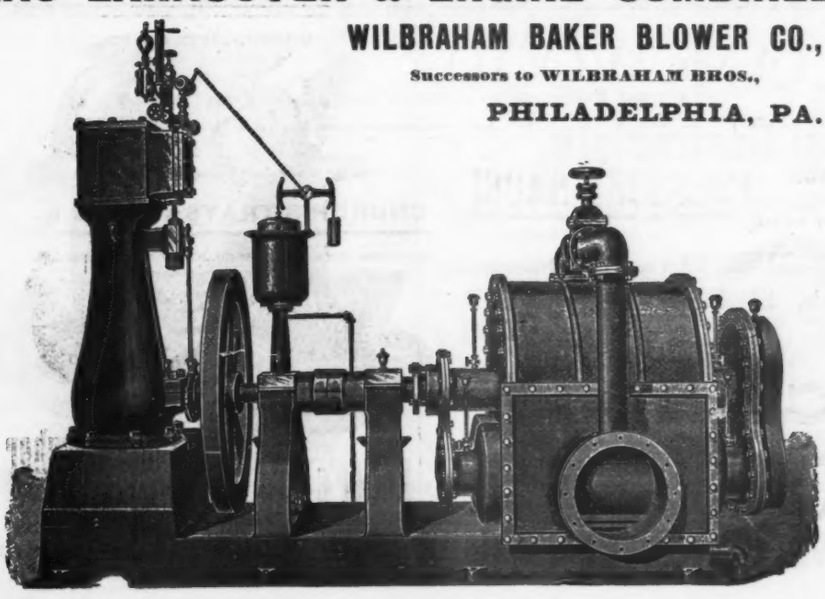

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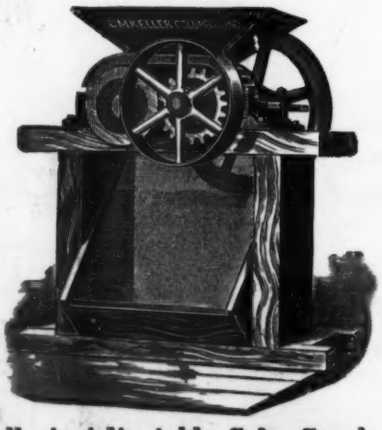

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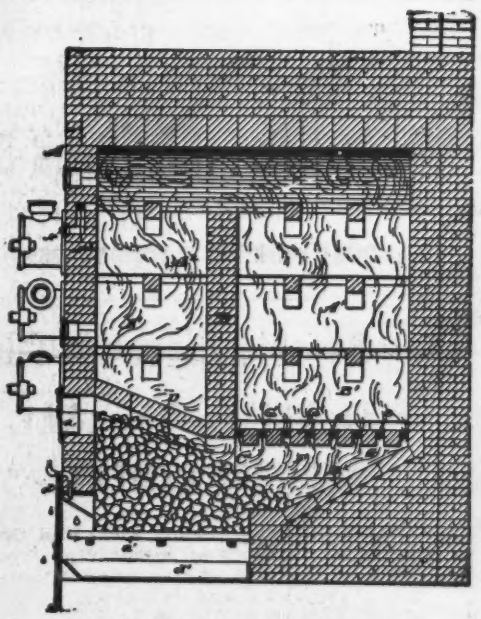

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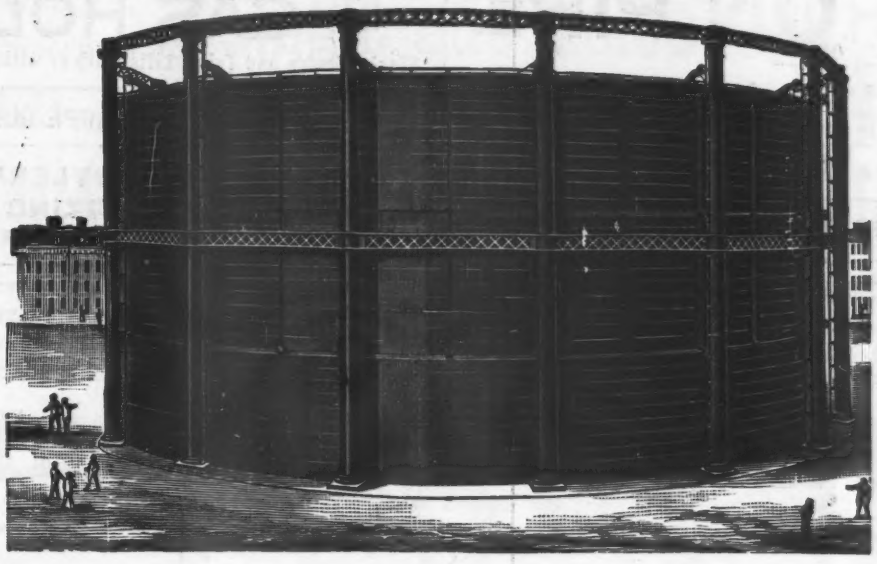

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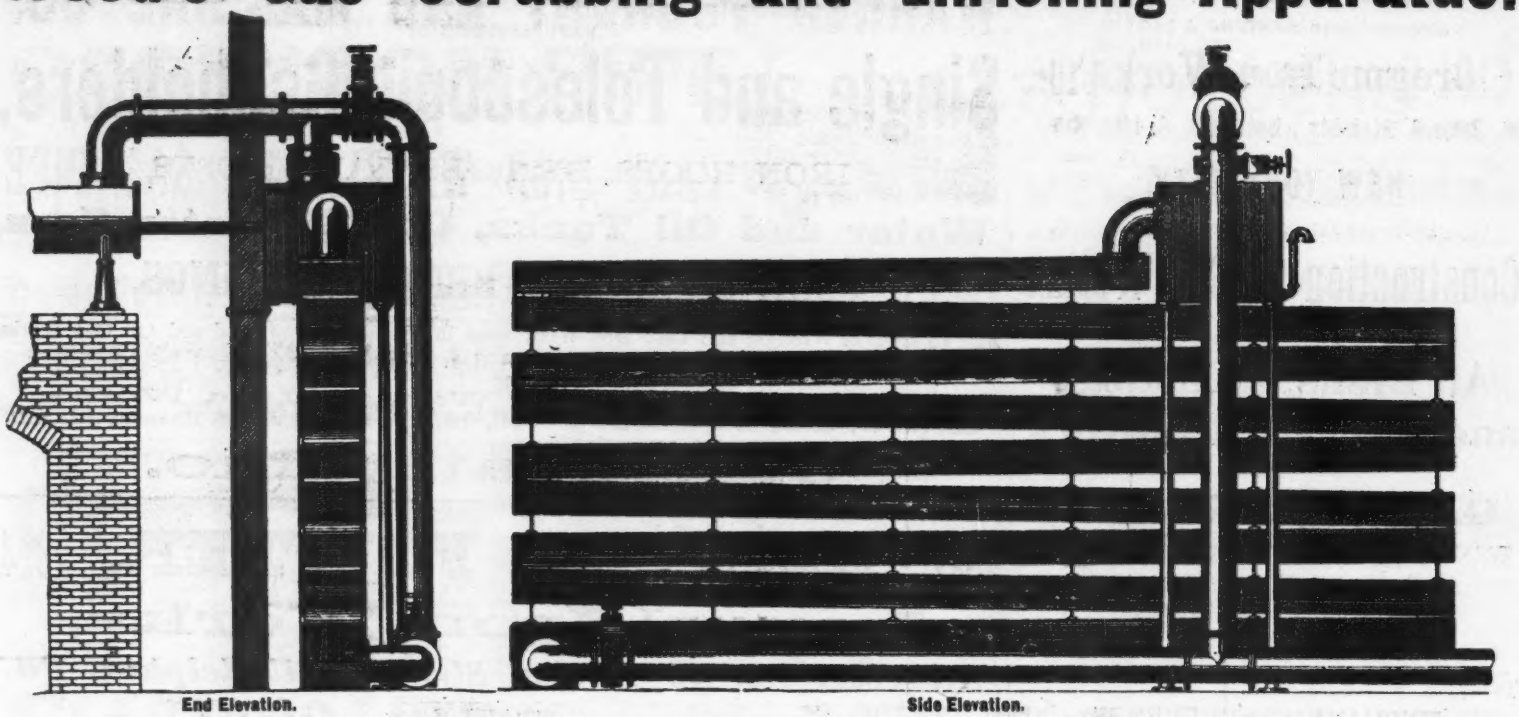

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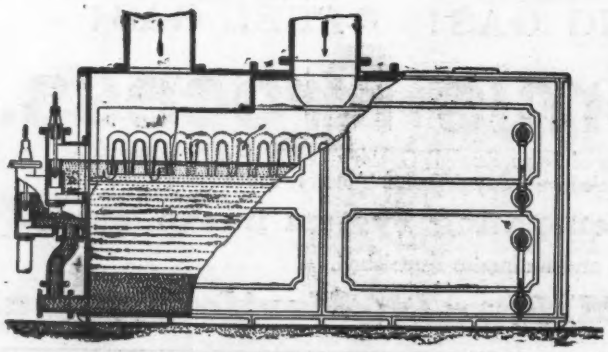

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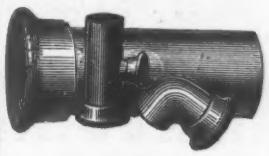

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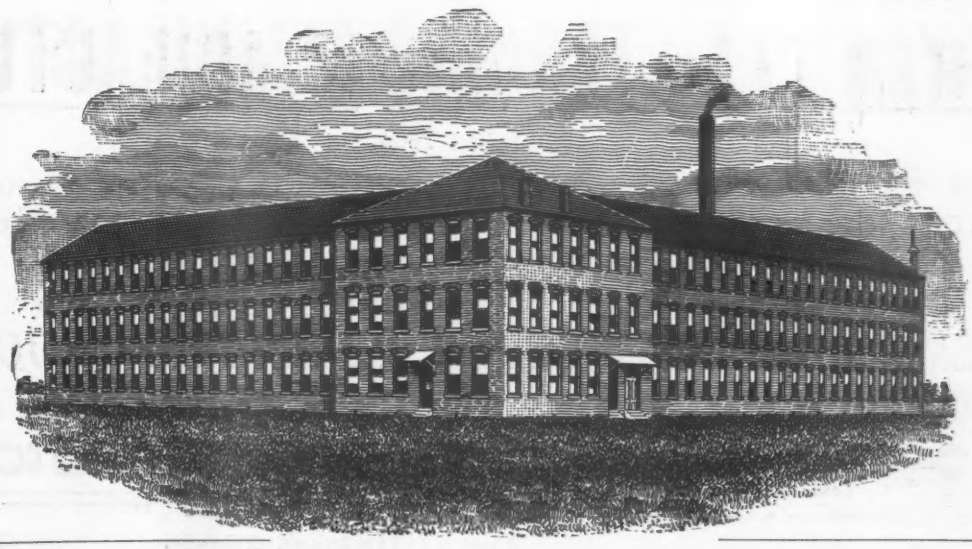

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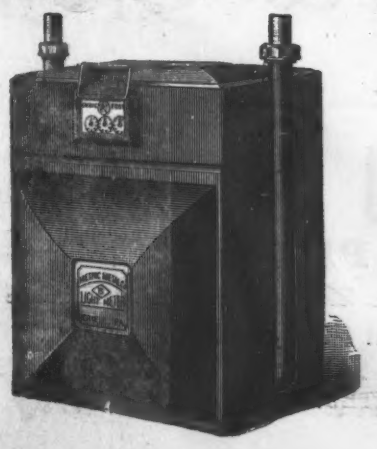

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